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George J. Heuer Birthday Volume

Vol. 23 MARCH, 1948 No. 3

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SURGERY

A Monthly Journal Devoted to the Art and Science of Surgery

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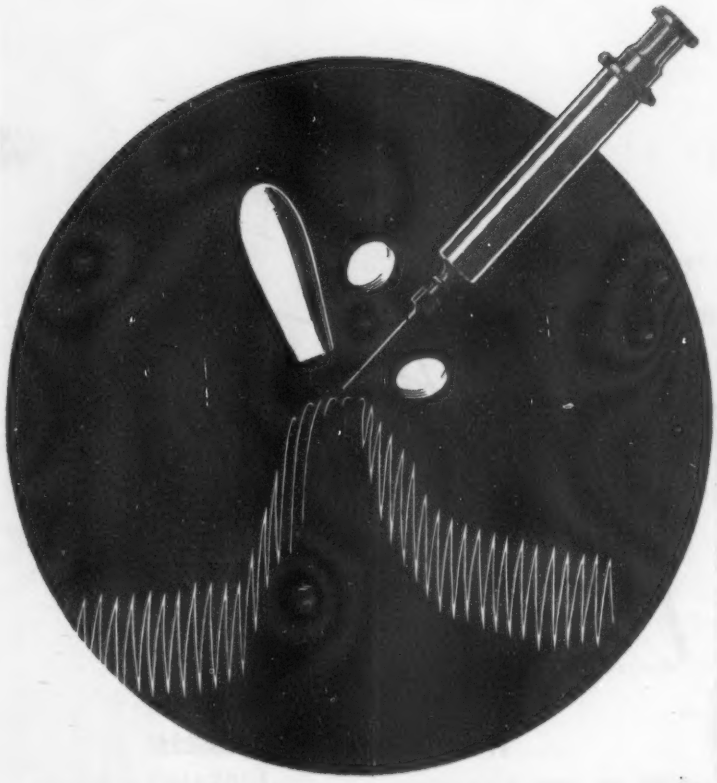
Vol. 23, No. 3, March, 1948. Surgery is published monthly by The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Mo. Subscription price: United States, its possessions, Pan-American Countries, $10.00 a year; Canada and Foreign, $11.00. Entered as Second-Class Matter January 20, 1937, at the Post Office at St. Louis, Missouri, under the Act of March 3, 1879. Printed in U. S. A.



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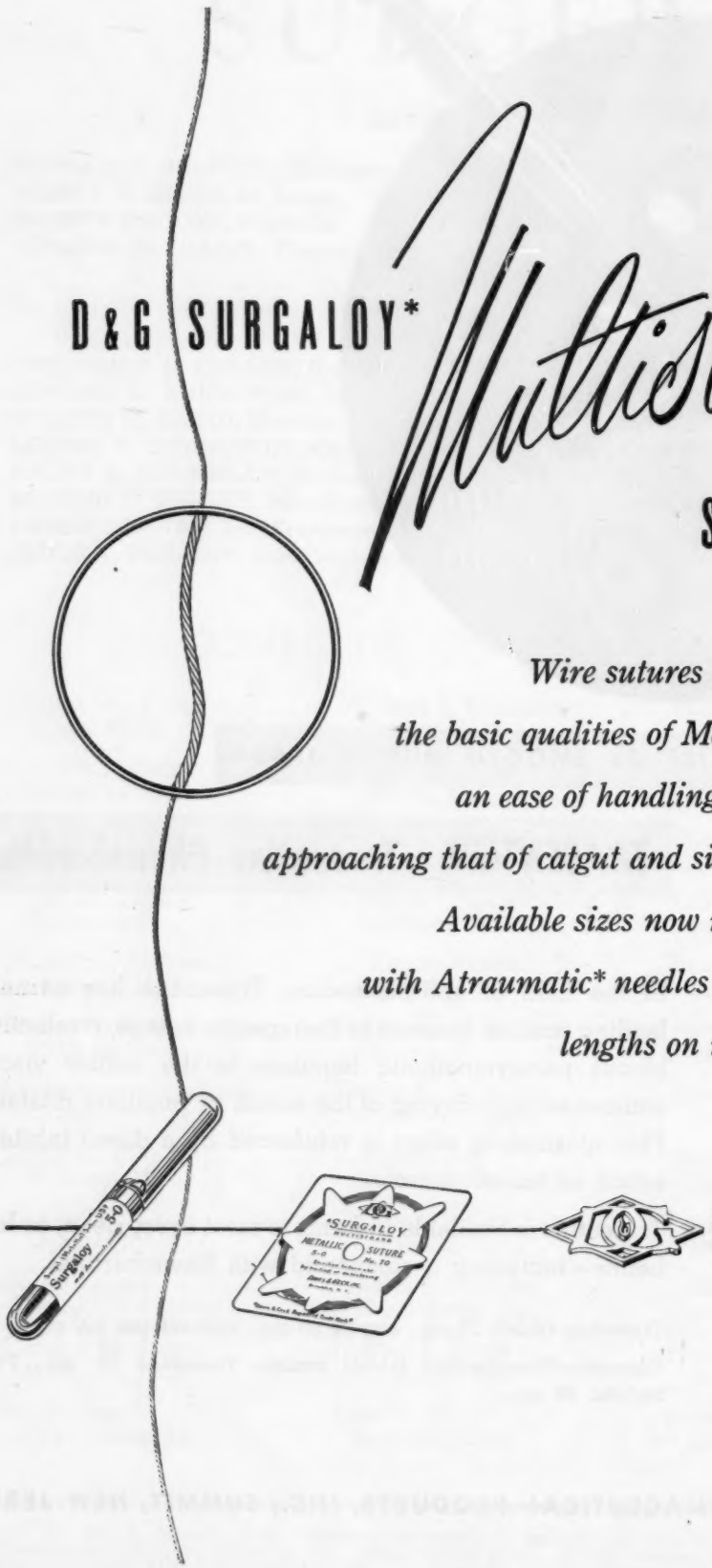

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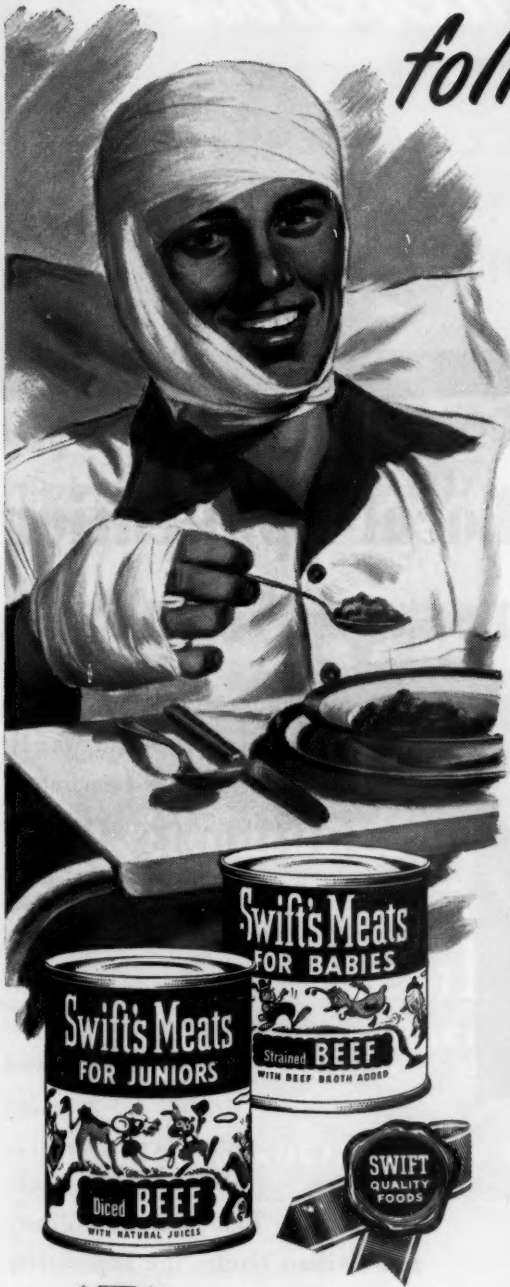

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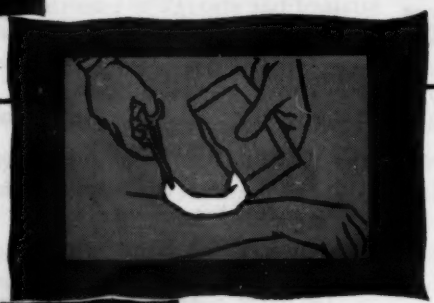

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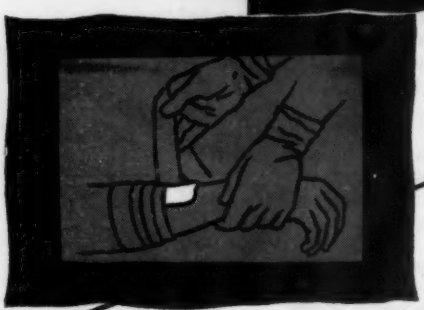

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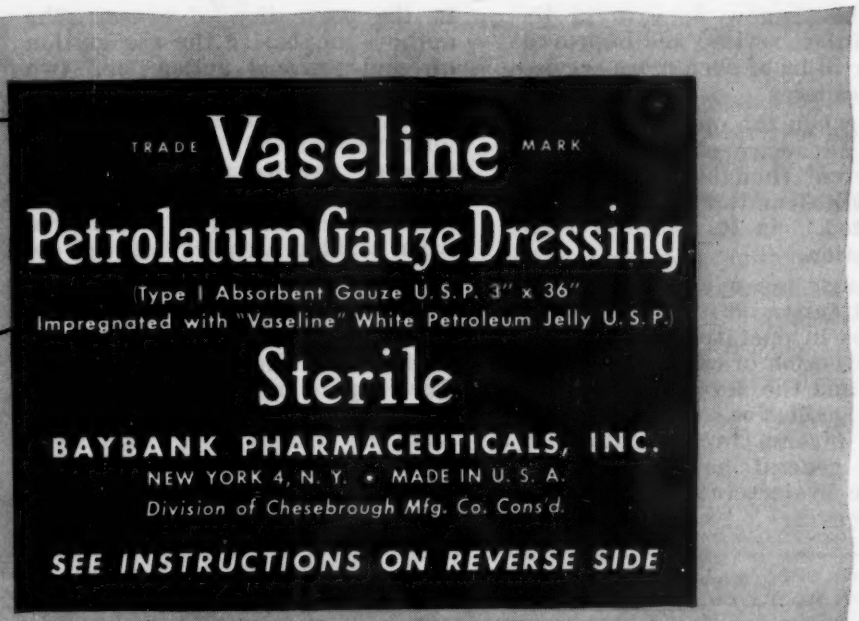
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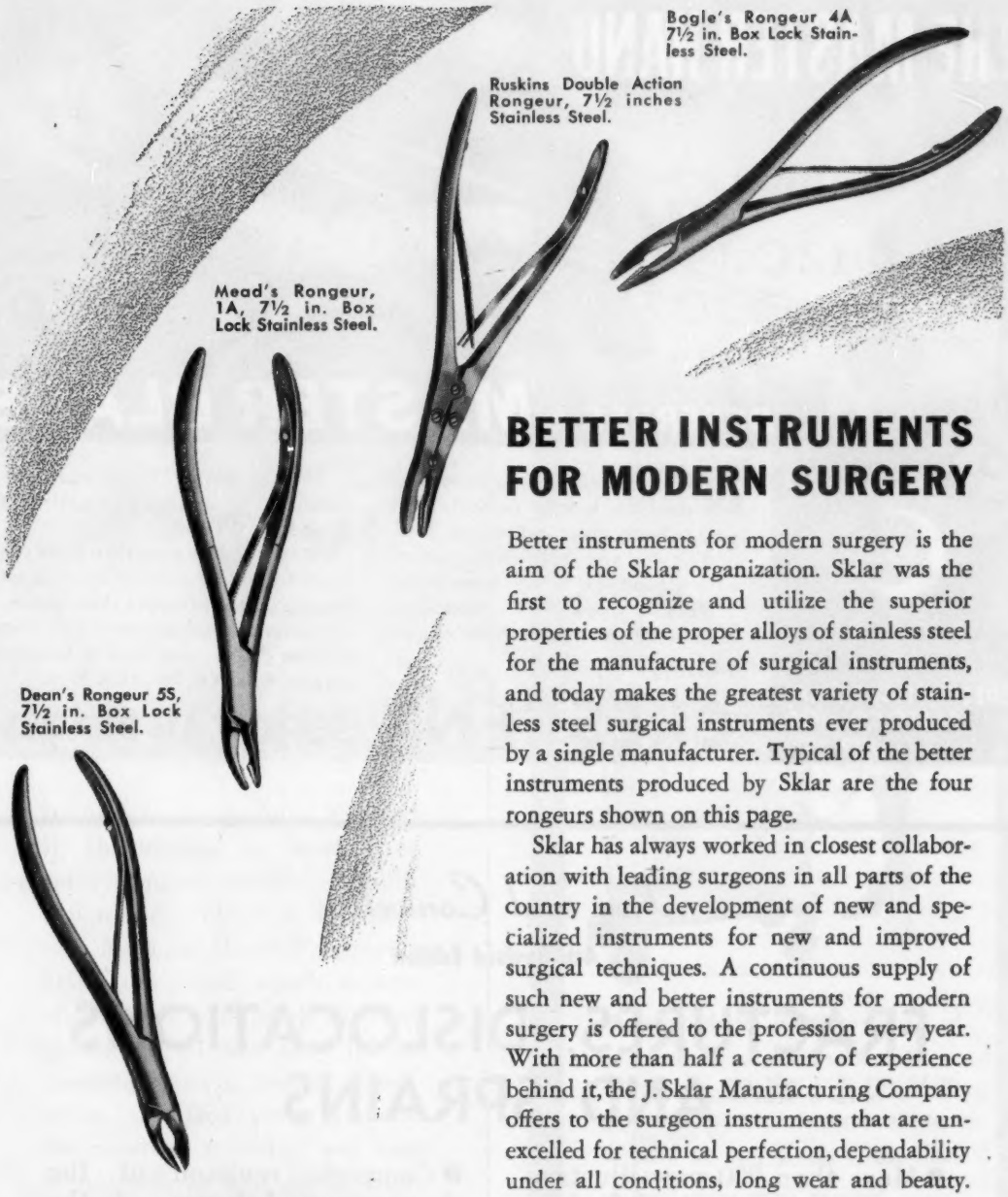

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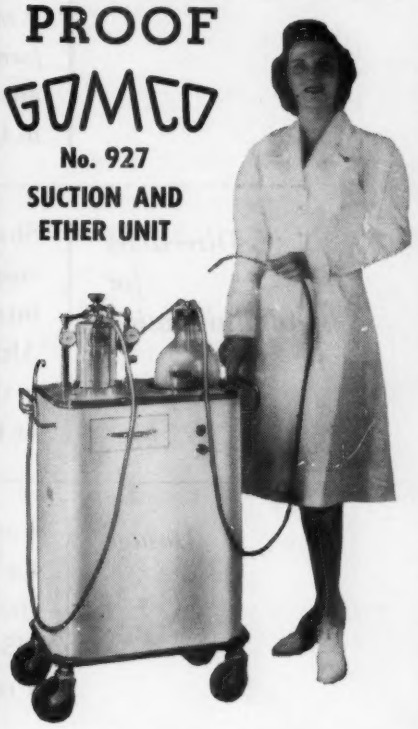

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SURGERY

VOL. 23 MARCH, 1948 NO. 3

George J. Heuer Birthday Volume

GEORGE J. HEUER'S CONTRIBUTIONS AND HIS PLACE IN AMERICAN SURGERY

WILLIAM DEWITT ANDRUS, M.D., NEW YORK, N. Y.

HAVING been closely associated with George J. Heuer for twenty-five years, I feel well qualified to speak of his personality, his detailed clinical and operative skills, and his teaching methods, and have therefore sought the aid of a number of his contemporaries who occupy high academic and professional posts throughout the country in estimating his place in American surgery. All have responded most willingly and the collected opinions in themselves constitute a glowing tribute.

Undoubtedly Dr. Heuer has made some of his greatest contributions as a teacher—both in the undergraduate and graduate fields—for unlike his preceptor, William Halsted, he is equally effective with residents and medical students. He brought to his rounds and clinics not only profound knowledge and concise formulation of subject matter, but often a certain light touch, accompanied by a twinkling eye, which served both to put a student at his ease who was making a creditable effort and to bring confusion to a bluffer or the overconfident. He always held as a major tenet of his teaching philosophy that the student should be given the greatest possible degree of independence in the way in which he learned, but as a corollary he expected diligence and a certain amount of insight. Neither the student nor the members of the resident staff could expect help unless they had already exerted themselves. No one could listen to his discussion of a case without realizing the breadth of experience which seemed immediately available in his clinical judgment. His diagnoses seemed almost occult at times, but were obviously the result of his enormous clinical contacts which had accumulated and been digested over a period of years. On occasion he could be somewhat disdainful of a diagnosis made by a lucky guess, expecting such to be arrived at by an orderly reasoned process and weighing of possibilities.

In his teaching he sought a balance between the new and the proved, and while not slow to adopt sound innovation, always insisted on the most careful

evaluation based on actual experience. Though always tolerant, he frequently pointed out the fact that patients were cured sometimes before the advent of sulfonamides, for example, and urged careful consideration of the dangers as well as the potential benefits of a drug or procedure before its adoption.

While all those under him worked hard, the department as a whole has been administered much more by leadership than by domination. Many matters were decided in group conferences, and all came to feel both that they knew what was going on in the department and that they had a share in its progress. He had himself experienced the Prussian rigidity of organization in Kuttner's clinic in Breslau where he had served as exchange resident in 1914, and the contrast to the atmosphere of Dr. Halsted's department made a lasting impression and was one reason for his preference for administration through the respect of the staff rather than by rigid discipline. How well he succeeded in this was frequently illustrated in his rounds where anyone—staff member, resident, intern, or student—felt free to present a differing opinion, which however he was then called upon to support. A foreign visitor commenting on the atmosphere of the rounds and of the department as a whole once said to me that it helped him to understand what liberty meant and to show him that it could be combined with discipline. The leadership which he provided was always one that brought his subordinates into the picture with as much responsibility as they could assume. Thus, he rarely gave a direct order but rather prefaced what he had to say by, "Don't you think that it might be well to do so and so . . . ," or "Do you like to do thus and so . . ." in a given case. This sometimes provoked discussion but certainly gave the recipient an idea of what was wanted and at the same time a feeling of a shared responsibility. Dr. Heuer believed firmly in the value of responsibility in promoting the progress made by members of the resident staff and commented on the way in which individuals burgeoned when advanced in status.

When he began his professorship in Cincinnati, the resident system, while well established at Johns Hopkins and a few other university clinics, was looked upon as impractical, if not perhaps undesirable, for other hospitals. It was felt that such a system was adaptable only to a rather narrow academic atmosphere and unsuited to the problems of the ordinary city hospital, for example. This constituted a challenge which he accepted with enthusiasm, and to many his greatest contribution has been the demonstration that the resident system was not only practical under quite diverse circumstances, but that it produced results in care of patients and in operative mortality which surpassed those of other types of organization. The details of the development of the resident system in Cincinnati are treated elsewhere by his first resident, B. Noland Carter, and the adoption of the resident system throughout the country is due in no small measure to this demonstration of its efficacy.

In 1935, participating in a symposium on the teaching of surgery before the American Surgical Association, Dr. Heuer presented a paper entitled "Graduate Teaching of Surgery in University Clinics" in which he traced the spread of such teaching throughout the country and analyzed its status at that time. In the conclusions which he drew from this study he stated, "The study shows

that . . . there are still lacking sufficient opportunities to meet demands of men seeking a higher degree in surgery and to meet the needs of the country in respect to trained surgeons.'' This symposium gave impetus to the founding of The American Board of Surgery, and Evarts Graham credits the stimulation of Dr. Heuer's address on this occasion with a large share in bringing this about. The widespread adoption of the resident system and particularly the high standards set by this Board eventually requiring what amounts to a thorough residency or its equivalent has been the source of intense satisfaction.

Except for a maintained interest and stimulation and an occasional appearance to demonstrate an operative method, Dr. Heuer has not been very active in the experimental laboratory during the last years of his tenure. His earlier work on pneumonectomy in dogs with particular reference to the healing of the bronchial stump was fundamental, however, and so exhaustive that little save minor alterations of the technique has been added since it appeared. He stimulated others to study the effects of removal of the lung on the remaining pulmonary tissue from both the anatomic and functional standpoint.

He later attacked several clinical problems in patients, including some of the earlier attempts to modify high blood pressure by means of operations on the nervous system, in one group of cases denervating the renal pedicle, in another performing extensive anterior root section. All of these patients were carefully observed, and while the procedures are no longer employed for this condition the observations were fundamental. With Harold Stewart and the writer he became interested in pericardiectomy for chronic constrictive pericarditis, and over a period of several years more than twenty such procedures have been carried out in consecutive cases without a death during the operation or in the hospital after operation. This work has been typical of his interests in bettering the operative results in various fields and the improvement obtained has been due not only to his own operative skill but also to a keen analysis of and attention to the critical features of the procedure, those responsible both for its good effects and for its mortality.

To his pupils and to many others, however, Dr. Heuer's ability as an operator has been his most outstanding achievement. Completely unruffled and at ease in the most trying situations, never seeming to hurry yet constantly moving forward, undertaking the most diverse and major procedures, yet always at home in each one, he has inspired everyone who watched. His own contemporaries and many others bear witness to this quality. One of them, the head of a university clinic, writes, ''I can repeat what I have said many times, that Dr. George Heuer is the most skillful surgeon I have ever seen do an operation. Other surgeons have perhaps equalled his skill in some of the particular fields of surgery, but I know no other surgeon who has shown such superior ability to operate in any part of the body. I have seen Dr. Heuer do all sorts of surgery with the exception of ophthalmological surgery and much of it was done in its early stage of development. I can remember no instance in which he was in trouble and did not have complete control of the situation.'' A similar opinion is expressed by many others, and one says, ''I think that George Heuer is probably the best living exponent of the meticulous surgical technique first intro-

duced into American surgery by his teacher, Dr. Halsted, and certainly he has improved on Dr. Halsted's technique. Dr. Heuer is noted for his sound surgical judgment, his ability to not go to the extreme, so frequently found with surgeons, and for his fearlessly espousing the thing he thought was right. He has certainly placed his love of surgery and of the teaching of surgery before all personal considerations. There is lots more I could say about him but there are so many other people who can say better than I." A third states, "I regard George Heuer as one of the ablest general surgeons of his generation in the United States and without a superior in the training of surgeons in the surgical clinics of this country. I first saw him work in the Evacuation Hospital No. 1 during World War I and his surgical judgment and technique were superb. To me his most productive period was at the University of Cincinnati where he revolutionized the surgery of the Cincinnati General Hospital and did an outstanding job in building up the teaching, research and training facilities of the surgical department. Later he established similar standards at the New York Hospital, and his accomplishments in these two institutions served to stamp him as one of America's ablest leaders in the field of surgical education."

When one attempts to define the secret of his great success as a surgeon one thinks at once of his knowledge of the operation itself gained from great experience, but added to this was the fact that he constantly learned, as he went along, always adapting the procedure to the existing situation. This he was able to do as he operated in a deliberate but by no means slow fashion, without any apparent tension. The atmosphere of quiet assurance was transmitted to his assistants and while alert, no one felt on edge; each was therefore able to contribute his best effort to the matter in hand.

One of the surgeons and professors of surgery in the country whom Dr. Heuer himself most admires writes of him as follows: "The feature which I think impressed everybody the most about him has been his great interest in the training and development of young surgeons. I am familiar with the difficulties which he encountered in introducing the resident system at Cincinnati. It was a new idea to everybody there that surgical patients could be entrusted to the care of residents without any increased danger. The great success of the program did much to help the cause of adequate surgical training throughout the country from which the public is now profiting greatly. Everybody also realized that he stood among the top surgeons of the world in technical ability and even brilliant operating skill. I always think that the fact that he was so excellent an operating surgeon and yet could champion the program of having the residents do much of the surgery helped greatly to have the program of resident training instituted more generally in other places in the country. One could safely assume that a surgeon of his skill would not be willing to advocate turning over the care of surgical patients to residents unless they were fully qualified to do the work in a thoroughly satisfactory way. I also have always placed a very high value on his original contributions and experimental work. His early experiments on pulmonary resections in dogs did much to encourage the more radical resections of pulmonary tissue in human beings."

Dr. Heuer's papers have been examples not only of scholarly writing but also of exhaustive treatment of his subject. The practice which he acquired in preparing manuscripts for Dr. Halsted's approval contributed to this skill, and he has frequently told of his experience with the first papers that he submitted, which were returned liberally pencilled—to be followed in rapid succession by the receipt of a *Webster's Unabridged Dictionary* and a copy of Quiller Couch's book on the art of written English. He was very critical of the writing of members of his staff, and the excellence of his papers has set a goal toward which his men have always aspired.

Dr. Heuer retired from his post at Cornell Medical College, July, 1947, after twenty-five years of full professorship there and at the University of Cincinnati. During this time more than one hundred surgeons have either gone through his residency or have obtained the major part of their training under him. Were his contribution limited to this, his high place in American surgery would be assured. His pupils join in honoring him on this occasion as teacher, investigator, and truly great surgeon.

TWENTY-FIVE YEARS OF A GRADUATE SCHOOL OF SURGERY FOUNDED BY GEORGE J. HEUER

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IN VIEW of great contemporary interest in thorough surgical training, and also because well-organized graduate schools of surgery which have had continuous existence for so long as a quarter of a century are comparatively few in number, an account of the founding of such a school at the Cincinnati General Hospital appears appropriate at this time. The Graduate School of Surgery of the University of Cincinnati was founded by George J. Heuer in 1922, and has enjoyed an unbroken tradition of surgical principles and teaching throughout twenty-five years. The school stands as a monument to Dr. Heuer's recognition of the need for proper facilities for thorough surgical training, to his untiring efforts toward supplying that need, and to the results which have ensued from application of the fundamental principles which he established. His stature as an educator and a preceptor is fully as great as his reputation as a practicing surgeon.

Having been trained in the resident system under William Halsted at the Johns Hopkins Hospital, and having served there in the capacity of resident surgeon from 1911 to 1914, Dr. Heuer brought this method of training to Cincinnati upon his appointment to the chair of surgery in 1922. Modifications of the original system to meet expanding needs for surgical training were made under Dr. Heuer and his successors, but its fundamental concepts have remained unchanged to the present time. In 1932 Dr. Heuer was called to the chair of surgery at Cornell, where he introduced and expanded the methods of training surgeons which he had established at Cincinnati. Mont Reid, another of Dr. Halsted's residents, and one of Dr. Heuer's associates, succeeded him as head of the school, augmenting the system of training while adhering to its original ideals. Dr. Reid was responsible for the continuing and advancing high standards of the school from the time of Dr. Heuer's departure until his own death in 1943. Since Dr. Reid's death the two other directors of the school have been individuals who received their training under Dr. Heuer, thereby maintaining the continuity of tradition and principles of the original training program.

THE HALSTED SYSTEM

Since the resident system of training which Dr. Heuer inaugurated at the Cincinnati General Hospital was patterned after that introduced into this country by Dr. Halsted around 1890, a description of the Halsted system seems warranted. At that time there existed in the United States no organized postgraduate training programs designed for young doctors who wished to become proficient in surgery. With the introduction and spread of the principles of asepsis and the expansion of surgical knowledge, increasing numbers of men turned their attention to this phase of medicine.

Dr. Halsted had been greatly impressed with the training given in the European clinics, and had noted the greater surgical proficiency of men trained in such clinics, particularly those of Germany and Switzerland, as compared with that of surgeons in this country. He believed that this difference was largely due to the more efficient and prolonged training offered abroad, and accordingly set about founding a system of training at the Johns Hopkins Hospital which should be comparable in scope to that offered in the best European clinics. His ideal was to establish a training which "... will produce not only surgeons, but surgeons of the highest type, men who will stimulate the first youths of our country to study surgery and to devote their energies and their lives to raising the standards of surgical science."[1]

In bare outline, the system adopted was pyramidal in structure, with a "resident" or house surgeon at the apex, and an indeterminate number of assistant residents under him. There was no regular progression of assistant residents to the top position, no specifically assigned services through which they rotated, nor any prescribed limits to their training. Since the house surgeon might retain his position for an indefinite period of time, opportunities for advancement were sharply limited, and many assistant residents left the institution before attaining to positions of real responsibility. The resident surgeon was in charge of, and responsible to the attending staff of the hospital for, all patients admitted on the surgical service. His position thus involved administrative duties as well as operative experience, and he was further expected to teach and direct the assistant residents under him.

This type of experience afforded exceptionally fine training for the man who reached the position of resident surgeon, and the prerogative of indefinite tenure of office enabled him to perfect his judgment as well as his technique before venturing to accept a position elsewhere. The chief defect in the program lay in its static quality, which prevented more than a very few men from obtaining the desired level of training. The assistant residents were given little authority or experience, frequently remained at one level of proficiency for long periods of time, and occasionally left the clinic before adequate training had been obtained.

To those who actually reached the position of resident, the advantages of this type of training were manifest, as may be seen by their subsequent interest and efforts in spreading its ideals. Of the seventeen men who held the residency under Dr. Halsted, five founded resident training programs, and an additional six held professorial positions in first class medical schools. The first graduate school to be founded by a Halsted resident, similar in scope and aims to that of "the Professor," was that introduced at the Peter Bent Brigham Hospital by Harvey Cushing in 1912. The second such training program to be established in the United States was that founded by Dr. Heuer at the University of Cincinnati in the Cincinnati General Hospital in 1922. In the ten-year interval between the founding of these two schools less than half a dozen schools for graduate surgical training were begun, and none of these were comparable in scope to that of Dr. Halsted. Several reasons for this apparent lack include the facts that at the time the long period of training was not deemed necessary or

advisable, the necessary facilities of university controlled hospitals were not available, and in the stage at which surgery then existed, the need for such training was not recognized.

THE GRADUATE SCHOOL OF SURGERY, UNIVERSITY OF CINCINNATI

At the time that Dr. Heuer brought the Halsted method to Cincinnati, only the system of postgraduate instruction offered at Peter Bent Brigham Hospital was comparable in caliber and scope to the original. Dr. Heuer followed the Halsted program very closely at first, having brought with him from Baltimore several men who had begun their training at Johns Hopkins. Only four men comprised the original group, a resident and three assistant residents.

The informal type of training which Dr. Heuer had originally advocated, with the assistant residents fulfilling whatever duties the resident deemed most necessary, was soon found inadequate for the rapidly increasing number of men seeking training. By 1924 nine men were in training, and by 1927 the resident staff numbered twelve. Under such conditions the necessity for more specific duties became apparent, and rotation through the various surgical services was begun. At first the assistant residents served on several of these, each man going through as many as seemed indicated. Later a more closely organized schedule of training was established, with each man spending a definite period of time on each service. Only minor changes have been made since Dr. Heuer's departure for Cornell; the services which are now offered appear in Table I.

TABLE I. SCHEDULE OF SERVICES

SERVICE	TIME (MO.)	NUMBER OF MEN
Surgical pathology	6	1
Experimental lab.	6	1
Dunham Hospital	6	1
General Surgery	6	2
Urology	6	1
Fractures	6	1
Holmes Hospital	6	2
Emergencies	6	1
Neurosurgery	6	1
Children's Hospital	6	1
Gynecology	6	1
First Ass't Res.	6	1
Residents	12	2
Total	7 years	16 men

Ideally, seven years are involved in the completion of all the prescribed services. Actually, however, all men do not participate in all services, nor is the period of time devoted to each always as long as is indicated in the table. The services do not necessarily follow one another in the order given. A brief description of each may show more clearly the experience which is afforded the assistant resident assigned to it.

Surgical pathology is combined with the tumor service, and the assistant resident on this service is responsible for the gross and microscopic description and diagnosis of all tissues removed in the operating rooms and outpatient

clinics. He is in daily association with a trained pathologist, with whom, in addition, he and the other surgical assistant residents hold biweekly conferences. He attends the Tumor Clinic twice weekly, and is responsible for the supervision of a special ward for the care of certain of the cancer patients.

In the experimental laboratory the assistant resident becomes familiar with the techniques and procedures of laboratory investigation. He acts as assistant to members of the senior staff of the department of surgery in the pursuit of their experimental studies, and is stimulated to develop a problem of his own during the period spent in the laboratory. He is enabled and encouraged to develop his technique in the performance of various surgical procedures on animals.

The Dunham Hospital is located several miles from the Cincinnati General Hospital, and is the County Hospital for tuberculosis. Men assigned here assist in thoracic surgery as related to tuberculosis, and perform some thoracic operations under supervision. Additional experience in thoracic surgery is obtained elsewhere in the training program.

General surgery is divided between two assistant residents. One takes the adult male wards; the other, the adult female and children's wards. At the end of three months they alternate. These men act as first assistants to the operators of their own patients. As they advance in training, they are permitted to operate under guidance. They are responsible to the resident for the management of all cases on their wards; assist in the teaching of senior medical students assigned as clinical clerks on surgical wards; and directly supervise the work of the interns.

Although urology is a division of general surgery, its attending staff comprises urologists, and it does not have a separate resident system. The assistant resident in surgery serves as urology resident for six months. He learns to do all of the urological studies, and is permitted to do part of the major surgery under supervision. He also manages the urologic dispensary and handles the bulk of consultation work.

The fracture service is also a branch of general surgery, and is without a separate resident staff. All patients with fractures, except those involving the skull, are seen in the admitting ward by the assistant resident assigned to fractures, who is responsible for their subsequent treatment and care. All patients needing skeletal traction are treated by him, as are all compound fractures. The attending staff operate upon those needing open reduction until the assistant resident is capable of operating independently.

The Holmes Hospital is a private institution where two assistant residents are posted. These men are assistants in all types of surgery except eye, ear, nose, and throat. The experience obtained here is extremely valuable and highly prized, and serves to give the assistant resident an opportunity to come in contact with private patients.

The assistant resident assigned to emergencies answers all calls from receiving ward physicians who seek surgical consultation. Patients with emergency cases of traumatic or inflammatory nature are first seen by this individual, who gives them complete study and prepares them for emergency therapy. He acts

as first assistant to the resident in the surgical treatment of all these cases night and day. In the discretion of the resident, he is permitted to perform operations independently. He is also in charge of the surgical dispensary in the mornings, where he sees elective surgical patients.

Operative work in neurosurgery is shared between the attending staff and the resident. Most of the work assigned to the resident is concerned with acute head injuries and peripheral nerve injuries. All house cases require complete neurologic study by the assistant resident assigned to this service.

The surgical service of the Children's Hospital is managed by an assistant resident rotating through that service from the Cincinnati General Hospital. He has all the privileges of a resident, taking care of emergency and elective surgery under the necessary supervision. The assignment usually comes late in his training as it is a post of great responsibility.

Gynecology, like urology, is a division of general surgery, but attended by a separate staff. Their resident is one of the surgical assistant residents. He works in the dispensary, performs physical examinations on admitted patients, and is permitted to perform major surgery for the usual pelvic and perineal disorders. The opportunity for such extensive experience in gynecologic surgery is a valuable adjunct to the training of a general surgeon, and is rather unusual in graduate schools of surgery. In view of the fact that a considerable number of trainees enter private practice in moderate-sized communities, this gynecologic training is of great importance.

The *first* assistant resident is next in line for the residency, and acts as an assistant to the resident. He relieves the resident of a number of the night emergencies, and of routine operative work when the latter is required for more difficult or important work. He arranges clinical material for student classes, makes complete rounds on mornings when the resident is occupied in the operating room, and takes charge when the resident is off duty.

The resident operates every day except Sunday from 8:00 A.M. until the work is finished. He sees all emergency patients and assigns the operator or operates himself. He answers all consultation requests by other services and arranges for the proper staff man to see the patients in question if it is necessary. He may choose to be first assistant in any case in which the operation is done by a staff member. He conducts members of the staff to the wards for advice or when they may wish to inspect the wards. He must check the work of all assistant residents under him. Although his responsibility is great, he knows that there is a staff man available should advice or technical assistance be necessary. The resident conducts a meeting of the entire house staff five evenings each week, at which time daily progress of every patient on the service is checked. During these meetings plans for further investigation are made, operations scheduled, and dismissals and follow-up dates for Sunday morning clinics made.

Appointments to the resident staff are made on a yearly basis, renewal of appointment being dependent on demonstration of ability. Should a man have been assigned to all services, he would have spent seven years by the conclusion of his residency. Since some of the services overlap and are not necessarily

repeated, nor is always the full six months spent on each service, it is exceptional for a resident to spend more than six years in training. A typical program is represented in Table II, which does not contain all the services listed in Table I. Several of the services now offered were included in the general service at the time this man was in training; the Dunham Hospital had not yet been established, and neurosurgery was then part of general surgery. In Table III the actual clinical experience of yet another resident is represented. In Table III under "patients admitted or treated," patients examined or treated in the various dispensaries were not included, and in "operations done," only hospitalized patients were counted.

TABLE II. EXAMPLE OF A RESIDENT'S TRAINING IN THE GRADUATE SCHOOL

SERVICE BEGINNING:	SERVICE	TIME (MO.)
Sept. 1	Surgical pathology	6
March 1	General surgery	6
Sept. 1 (2nd year)	Urology	6
March 1	Emergencies	6
Sept. 1(3rd year)	Holmes Hospital	6
March 1	Children's Hospital	6
Sept. 1 (4th year)	Fractures	6
March 1	Gynecology	6
Sept. 1 (5th year)	Resident	12
	Total	5 years

As is apparent, with the introduction of a specific course of instruction a more definite time limit for the completion of training was necessarily set. Because of the regular progression through most of the special services, and also because of the increased number of men completing the training each year, it became necessary to limit the term of the resident to one year, instead of leaving it to the option of the incumbent.

Dr. Heuer's goal was to fulfill the ideals which Dr. Halsted had established in the founding of the resident system at Hopkins, and although he modified the actual program in order to give more thorough training to a greater number of men, he never lost sight of the aims and principles on which the original system was founded. As the demand for training became more widespread, the curriculum was altered, expanded, and made more specific. In place of the informal

TABLE III. CLINICAL EXPERIENCE OF A TRAINEE IN THE GRADUATE SCHOOL

SERVICE	TIME (MO.)	PATIENTS ADMITTED OR TREATED	OPERATIONS ASSISTED	OPERATIONS DONE	TOTAL OPERATIONS
General surgery	6	624	355	108	463
Orthopedics	6	196	142	22	164
Holmes Hosp.	6	132	112	0	112
Fractures	4	410	14	1	15
Asst. Res.	2	452	24	129	153
Gynecology	6	700	165	98	263
1st Asst. Res.	9	2,430	No record	359	359
Emergencies	6	164	103	26	129
Resident	12	2,890	22 (staff)	685	707
Total	4 yr. 9 mo.	7,998	937	1,428	2,365

type of instruction offered by the earlier plan, Dr. Heuer inaugurated several regularly held formal meetings. These include ward rounds conducted by a member of the attending staff three afternoons weekly, and the biweekly clinical-pathologic conferences held under the joint direction of members of the attending staffs in surgery and pathology. There is also a weekly seminar at which the members of the resident staff discuss with members of the senior staff the current work of the department and relate to it recent or pertinent literature.

Recently, by cooperation with the department of anatomy, a specialized course in dissection under joint supervision of members of the departments of surgery and of anatomy has been offered to a limited number of assistant residents. Dissection under supervision for three hours once weekly is supplemented by additional independent work. Upon completion of the course, assistant residents aid in teaching the course in regional surgical anatomy given junior medical students.

A more direct outgrowth of the informal discussion method of teaching appears in the conduct of surgical grand rounds. At these weekly meetings of the entire resident and attending staff, emphasis is placed on informal discussion of cases following their formal presentation by a member of the house staff. Notes on cases to be presented are compiled in a concise yet complete manner and distributed at the meeting, and exchange of opinion predominates in the ensuing discussions. The director of the surgical pathology laboratory attends these meetings, emphasizing the correlation of his specialty with surgical principles and procedures. The hospital roentgenologist is also present to discuss roentgenologic diagnosis. Frequently several members of the medical service attend and present other aspects of the total clinical picture in any given case.

With all the modifications which Dr. Heuer introduced in order to facilitate the expansion of the scope and quality of the training, the lofty ideals remained essentially those of Dr. Halsted. Among the most emphasized of these ideals was that of the desirability of the assumption of great responsibility by the resident surgeon. In 1927 Dr. Heuer wrote, "The assumption of this heavy responsibility which develops on the senior graduate student or resident surgeon is, in our opinion, one of the greatest features of this course."[4] The chief resident is responsible, as has already been indicated, for the care of all patients admitted on the surgical service; and having assisted at operations and operated under supervision during the first four of five years of his training, he performs major surgical procedures on his own responsibility and makes decisions as to the pre- and postoperative care of the patients in the hospital. Not only are his clinical duties stressed, but also his responsibilities with regard to the direction of the assistant residents under him. He is expected to guide and advise the younger men, both through example and informal discussion.

Despite the increase in the number of men accepted for training, no compromise with the quality of their education has been made. The period of time required for the completion of the work remains from five to seven years, during which time experience in the various surgical specialties as well as general surgery is acquired. The comprehensive nature of the program was designed not only for the acquisition of skill, but particularly for the develop-

ment of judgment. Dr. Heuer believed that, "Perhaps most striking in the longer courses is the emphasis placed upon individual responsibility as a means of developing character, surgical diagnosis, technic, and judgment."[5] He insisted upon the necessity for repetition of experiences in order that the individual might learn to exercise care and accuracy in diagnosis and treatment.

Although the Graduate School of Surgery at the Cincinnati General Hospital is an outgrowth of the Halsted system in that it comprises Dr. Halsted's ideals, the ever-increasing demand for surgical training has necessitated revision and expansion, which have been effected without any compromise of quality. In 1933 Dr. Heuer stated his ideals as follows:

> I have my own idea what, from an educational viewpoint, these men should be. They are men who have had a rather broad fundamental training in the sciences related to medicine, and a specialized training after their graduation in medicine in surgical pathology, surgical diagnosis, preoperative and postoperative treatment, and in operative surgery. Their training in general surgery has included the specialties in urology, orthopedic surgery, and gynecology. Their operative experience has been large, and acquired by assisting their seniors, by the performance of surgical operations under their direction, and by the independent performance of major surgical operations. In addition to this clinical training, they have acquired experience in and become imbued with the desire to pursue research, and they have acquired experience in teaching and in departmental organization. More and more I am realizing that all this is not enough; that the men I would seek to develop shall have acquired a spiritual experience as rich as their surgical experience, which enables them to follow only the highest ideals of medicine.[6]

With but minor variations the system and ideals are today as Dr. Heuer envisoned and established them.

Although it is difficult to evaluate anything as intangible as the influence which a set of ideals may exert, the growth and spread of the resident system since its inception at Johns Hopkins, and particularly the acceleration of this spread since the founding of the Graduate School of Surgery at the University of Cincinnati by Dr. Heuer, lead us to believe that this school has played a not inconsiderable part in the expansion. The impetus for the increased awareness of the need for, and subsequent development of, such systems stems in large part from Dr. Heuer's vital interest in the training of surgeons. Twenty-two years elapsed from the initiation of the resident system at Hopkins until the founding of the Brigham Hospital. Using the list of schools approved by the Society of University Surgeons, it appears that in the ten years which separate the founding of the latter school and that at Cincinnati, four schools were established, but beginning two years after the founding of this clinic, and continuing down to 1936, fifteen fully accredited schools came into being. Men who have been graduated from this clinic and from others similar in purpose have set out to raise the standards of surgical education all over the country. In place of half a dozen schools affording postgraduate training of any sort whatever, as was the condition in 1922 when Dr. Heuer came to Cincinnati, there are now twenty-two clinics offering the intensive and specialized training required for accrediting by the Society of University Surgeons, and nearly 300 which meet the requirements of the American College of Surgeons. Although sufficient opportunity for first-

class surgical training is not yet available for all who desire it, significant strides have been made since Dr. Halsted's first efforts in that direction over fifty years ago, and since Dr. Heuer's continuing emulation of his ideas and ideals during the past twenty-five years. Perhaps no single individual has done more than Dr. Heuer in laying before the eyes of his colleagues the need for such training programs.

RESULTS OF THE RESIDENT SYSTEM OF TRAINING

It is impossible to trace the ever-widening sphere of influence of Dr. Halsted's teaching, for in addition to the men who actually trained under him in the capacity of resident or assistant resident, there is the "second generation" of men trained by the first group. Without taking account of the intangible influences which may have been exerted, it may be stated that over half of the twenty-five most outstanding graduate schools in the United States were founded by either first or second generation Halsted pupils.

Dr. Halsted's purpose in founding the resident system of graduate surgical training was to produce "surgeons of the highest type" who would by precept or example raise surgical standards throughout the country. His goal was realized in that two-thirds of his seventeen residents became full or associate professors of surgery and one-third entered private practice. Six graduate schools of surgery were founded by five Halsted residents, Dr. Heuer having played a major role in the establishment of two such training programs; and a sixth resident, Mont Reid, continued in the tradition by following Dr. Heuer as head of the Cincinnati school.

The parallel between the results obtained by Dr. Heuer in his graduate schools of surgery at Cincinnati and by Dr. Halsted is striking, for of the thirty-three men who have held the position of resident at the Cincinnati General Hospital, including the six "war residents" who did not serve the full period of time, as well as the two present incumbents, two-thirds are engaged in teaching, and one-third are exclusively in private practice. Of those who are teaching, eight are full or associate professors, seven are assistant professors, and the others, largely the group of more recent graduates, hold lesser teaching positions. Of the sixty-four assistant residents, seventeen are still in training here, having returned from military service to complete their postgraduate work, and thirteen are still in service. Nineteen of the remaining thirty-four hold teaching positions, and fifteen are in private practice. Of the latter group, ten were here for only three years or less; hence they cannot be regarded as "graduates" of the school. Of further interest is the fact that forty, or 60 per cent, of the entire group of sixty-five residents and assistant residents who are not either in training or in service are actively engaged in postgraduate surgical training programs approved by the American College of Surgeons.

A further indication of the value of the training may be seen by a tabulation of the recognition accorded the sixty-five men not still in training or in service through membership in national surgical societies. Thirty-two, or half, are diplomates of the American Board, either of surgery or of the surgical specialties, in spite of the fact that many of the more recent graduates are not yet

eligible for examination by the Board. Twenty-six men are Fellows of the American College of Surgeons, fourteen are members of the Society of University Surgeons, seven of the Central Surgical Society, five of the American Surgical Society, four of the Western Surgical Society, four of the Southern Surgical Society, three of the Society of Clinical Surgeons, two are full members and five associate members of the American Association of Thoracic Surgeons, and one is a member of the American Association for the Surgery of Trauma.

Although the majority of men trained at the Graduate School of Surgery of the University of Cincinnati have remained in the state of Ohio, the geographic distribution by states, exclusive of the men still in training or in service, shows dissemination throughout twenty-three states (Fig. 1).

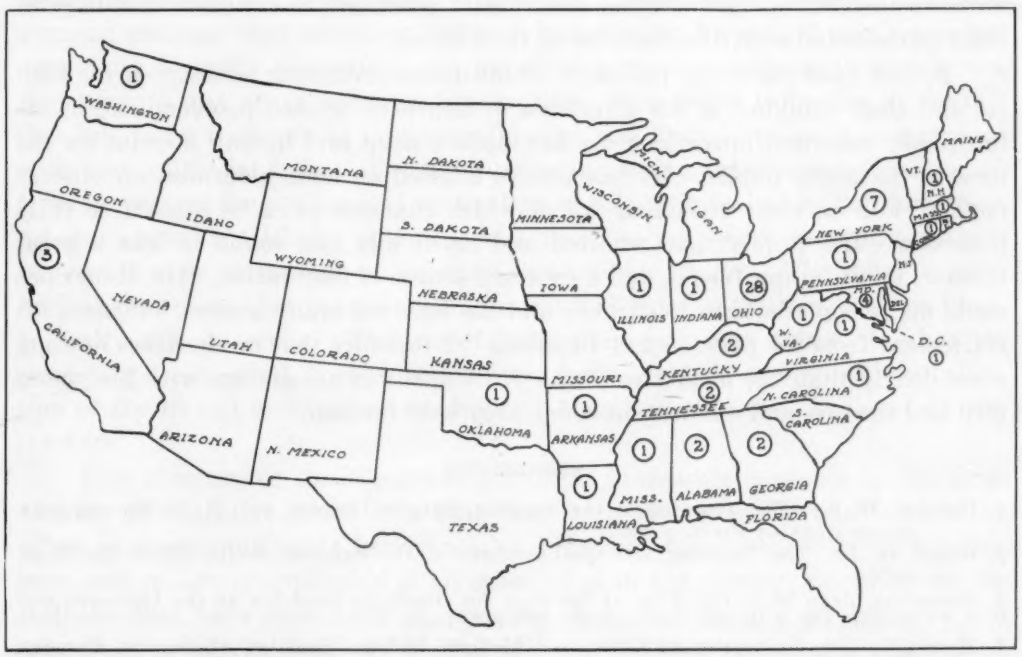

Fig. 1.—Geographic distribution of men trained in the Graduate School of Surgery, Cincinnati General Hospital.

Of the 100 living men who had received training under the resident system at Cincinnati, 70 per cent entered some branch of military service. Three lost their lives during the war and thirteen are still in service. Of the remaining fifty-four, one was director of the surgical consultant division of the Surgeon General's Office, two were surgical consultants to Service Commands, twelve became chiefs of surgical service in general hospitals, four were chiefs of service in the various surgical specialties, and five were assistant chiefs of surgical service. Three men were division surgeons, two were chiefs of surgical sections, and one was engaged in research programs both in this country and in the European Theater of Operations. Over half of those who entered the service (55.5 per cent) rose to positions of considerable responsibility. Such statistics serve as only a rough indication of the value of the type of training offered in the graduate school.

An account of the activities of a school of surgery founded and nurtured by Dr. Heuer would not be complete without some mention of his personal relations with the men who have been privileged to work under his direction. The splendid record of his pupils, so many of whom are included among the present and future leaders of surgery, and the magnitude of his accomplishments in furthering the application of basic surgical principles speak for themselves, but even more important are the personality and character of the man who has so unselfishly spent his life pursuing his ideal of giving young men an opportunity to obtain a superb training in surgery. It can be truthfully said that of the many interests in Dr. Heuer's surgical life the foremost has been his surgical schools. He has always intensely concerned himself with each of "his men," spending much time and thought in planning their careers, stimulating them to improve themselves, and offering kindly and constructive criticism, not only of their professional activities, but also of their ideals.

By the example of his industry, of his uncompromising honesty, of his logical and clear thinking, of his directness of approach to each problem, and of his faultlessly executed operations, he has made a deep and lasting imprint on the lives of his many pupils. He has always insisted on meticulousness, on orderly method, and on clear reasoning, all of which characteristics he himself so fully possesses. His pupils have admired and loved him and found in him a great teacher, an unfailing friend, and a constant source of inspiration. Dr. Heuer has made many contributions to surgery and has received many honors, but upon his retirement from his position as "Professor" I feel sure that he cherishes nothing more dearly than the memories of the years spent in association with his young men and the love and admiration which they hold for him.

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SOME EXPERIENCES WITH ANASTOMOSIS OF THE COMMON BILE DUCT TO THE DUODENUM, AND REPAIR OF STRICTURES OF THE COMMON BILE DUCT

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STRICTURE of the common bile duct frequently leads to partial or prolonged invalidism of the patient, and its repair may tax the resourcefulness and ability of the surgeon. The latter must also be aware that a well-planned and executed operation followed immediately by a good result may not eventually be really successful. All too often, after months or even after years, the stricture may recur and jaundice develop. This seems to be due to the fact that bile has a tendency to produce adhesions and fibrosis unless it is contained within an epithelial lining. For this reason, in making anastomoses of epithelial-lined structures for purposes of conduction of bile, it is desirable that mucosa-to-mucosa approximation be obtained, and that healing occur promptly without suppuration or formation of excessive granulation tissue. The more rapidly healing occurs so that the suture line is covered with epithelium, the less likely is contracture to occur. The use of indwelling catheters, tubes, etc., has the same purpose in mind, that is, to maintain patency of the tube until epithelization of the line of anastomosis is complete, thus reducing the likelihood of contracture.

That stricture of the bile ducts is difficult to manage is shown by the large number of operative procedures that have been recommended and used in an effort to obtain uniformly better results. None of them seems wholly satisfactory, and no one is applicable in all cases. I shall not attempt to review all the methods that have been used or described, but shall confine my remarks and comments to only a few. It is generally agreed that end-to-end anastomosis of the duct usually with a permanent or temporary indwelling tube or catheter is the method of choice when it can be accomplished. The maneuver recomded by Cattell[1] to achieve this result, namely mobilization and freeing of the descending duodenum to expose the retroduodenal portion of the common bile duct, can aid greatly in obtaining a greater length of duct than would otherwise be available. By the use of this procedure he has been able to accomplish end-to-end suture much more frequently than any other surgeon who has written on this subject. The methods of Allen[2] and Cole and associates[3] for reconstruction of the duct when only a stump of hepatic duct remains have also proved highly successful in their hands. These methods are more or less similar in that they make use of a loop of jejunum, defunctionalized by the Roux Y procedure, to replace part of the missing bile duct system and conduct bile from the hepatic ducts to the intestine. They differ in certain important details, Allen using a removable rubber tube, and Cole and his co-workers a

permanently placed vitallium tube. Both of these authors pointed out the danger of possible ascending infection from the intestine into the biliary tract as a result of direct anastomosis of the bile duct system to duodenum or jejunum without the use of a defunctioned loop of bowel, and their operations have been devised to obviate this danger.

While it is my opinion that ascending infection is a real hazard, I have nevertheless performed direct anastomosis of the common or hepatic ducts to the duodenum a sufficient number of times without evidence of subsequent development of infection in the liver to make me believe that the danger is not so great as to warrant discarding completely this operative procedure. Many of the patients I have seen have been subjected to a number of previous operations, so that the entire upper abdomen was a mass of adhesions. Under such circumstances, the direct anastomosis of the hepatic duct to the duodenum is a procedure of considerably less magnitude than is the freeing and partial transplantation of the jejunum; moreover, the operative field can often be limited to a comparatively small area in the epigastrium usually no entrance into the free peritoneal cavity being made. If the results obtained are satisfactory, this smaller operative procedure may be of some importance to a patient whose general physical condition may not be and often is not particularly good. As a result of what has transpired in some of these cases, it is my belief that a direct anastomosis of this sort may be well tolerated by the patient as long as the opening remains sufficiently large so that any intestinal content that enters the biliary tree can easily return to the intestine. On the other hand, if stricture recurs so that the contents of the biliary tract are partially blocked, signs and symptoms of ascending infection develop, but are always associated with signs of bile duct obstruction. These signs are very similar to those seen when a stone in the common duct acts in a ball valve fashion, that is, there is pain, nausea, vomiting, chills and fever, followed by jaundice.

As evidence that direct anastomosis of this sort is not necessarily followed by ascending infection I should like to cite the following four cases.

CASE 1.—C. S., a white woman, 30 years of age, was admitted to the hospital Nov. 1, 1940. She had been in an automobile accident Feb. 21, 1940, at which time abdominal injuries were sustained. On February 26, an exploratory operation for so-called "intestinal obstruction" revealed several areas of rupture of the liver. In June, 1940, for reasons not entirely clear, a therapeutic abortion was performed. Following this procedure a transient, painless jaundice developed. In August, 1940, jaundice recurred and remained continuously present until the time of admission. There was no pain, nausea, or vomiting. There had been several shaking chills followed by fever. The icteric index varied from 110 to 150 units. There was a trace of bile in the duodenal contents. All studies suggested an obstructive jaundice. She was operated upon Nov. 16, 1940. The liver appeared normal, the gall bladder moderately distended and hard. There seemed to be a small area of fibrosis just where the common duct disappeared behind the duodenum, with some yellowish discoloration suggestive of an old hematoma or fat necrosis. The common duct was opened transversely just above the duodenum. There were no stones. At the site of the fibrotic area, the common duct was completely stenosed. The duodenum was opened, and a choledochoduodenostomy was performed using a continuous circular suture of catgut, reinforced by anterior Lembert sutures of silk. Several cigarette drains were placed down to the site of anastomosis.

There was a little bile drainage from the wound November 18, which quickly ceased. The patient was discharged from the hospital Dec. 7, 1940. On that day the icteric index was 16 units. The patient has remained quite well ever since. There were no chills and no jaundice up till June, 1946, when she was last heard from.

CASE 2.—C. D., a white man, 32 years of age, was first admitted to the Cincinnati General Hospital, January, 1936, with probable acute cholecystitis, and discharged the following day against advice. He was readmitted Sept. 21, 1936, with jaundice, pain, nausea, and vomiting and operated upon Sept. 28, 1936, by a staff surgeon. The gall bladder was thin, contained no stones, and was removed. The common duct was opened, two faceted stones and much gravel were removed, and the duct was washed until clean. The ampulla was dilated to 6 mm. diameter and the common duct was closed and drained with a catheter inserted into it through the stump of the cystic duct. The patient had a stormy postoperative course. The tube drained poorly, there were acholic stools, and considerable abdominal pain and nausea for some time. He was discharged apparently well on Oct. 28, 1936, but returned five days later with an abscess of the abdominal wall. This was opened, bile and pus being drained. The patient improved and was discharged on the seventh day, Nov. 9, 1936.

He remained fairly well but with a number of attacks of pain, chills, fever, nausea, and jaundice. He was readmitted Sept. 26, 1938, with an icteric index of 68. He was reoperated upon Oct. 5, 1938. The common duct was found to be dilated and filled apparently solidly with small stones and puttylike material. It was again cleansed as thoroughly as possible, the ampulla dilated, and the common duct drained with a catheter. The postoperative course was uneventful.

He was readmitted on the Medical Service, July 10, 1939, with a history of recurrent pain and inconstant jaundice. At this admission the icteric index was 75 units. He was treated by repeated duodenal drainages and left the hospital improved, on the tenth day, against advice.

He was admitted to the Holmes Hospital as my patient May 29, 1941, again complaining of jaundice, epigastric pain, and loss of weight. Operation was performed June 3, 1941. The common bile duct was the size of a thumb and felt like a solid structure. It was opened transversely. Claylike material completely filled it from the ampulla to the right and left hepatic ducts. This was scooped out and the ducts carefully washed with salt solution. The ampulla was dilated to 6 mm. diameter, but since the widest diameter of the common duct was 14 to 15 mm. it was thought that this funnel-shaped area might predispose to stasis. Therefore a loop of jejunum was brought up and anastomosed to the opening in the duct with a continuous circular suture of catgut, reinforced with interrupted sutures of silk.

He developed a hematoma in the wound, but no dangerous bleeding. The hematoma became mildly infected and continued to drain for some time, but finally healed leaving a small ventral hernia. The jaundice quickly subsided and the patient has remained well since. He was last seen in June, 1947.

CASE 3.—G. W., a white woman, 68 years of age, was admitted to the Cincinnati General Hospital, Jan. 8, 1942, with jaundice of six weeks' duration. The icteric index on admission was 80 units. The jaundice had been relatively painless and progressive. There was considerable difference of opinion regarding the cause of jaundice, but when the roentgenogram showed a dozen or more stones, some in the gall bladder and others in a rather linear arrangement, the majority opinion was common duct stone. This patient was quite obese, had had several hospital admissions for cardiac decompensation, and was a poor operative risk; it was decided to carry out the simplest operative procedure possible. Operation was performed Jan. 24, 1942. The gall bladder was enlarged and contained numerous stones. The common duct was dilated and there was a hard mass in the region of the ampulla. The gall bladder was opened. It contained bile-stained fluid and a number of stones. No free bile was obtained although it was thought that all stones had been removed. The common bile duct was therefore opened. It contained thick, dark bile, but no stones could be found. The ampulla admitted a tiny probe with difficulty. The apparent diagnosis was carcinoma of

the ampulla or head of the pancreas. Since radical operation did not seem feasible, the common duct was anastomosed to the duodenum and the gall bladder was drained. Subsequent events proved it would have been better to have removed the gall bladder, for the patient continued to have an external mucous fistula with multiple infections of the anterior abdominal wall; roentgenograms showed that one stone had been left behind. The jaundice cleared, however, and digestion remained good. There were no chills. She died at home in the spring of 1943, apparently in cardiac decompensation. There was no autopsy.

CASE 4.—J. A. McD., a white man, 68 years of age, was first operated upon Oct. 11, 1943, with diagnosis of subacute cholecystitis and cholelithiasis. The gall bladder was removed and a T tube inserted into the common duct. Apparently no stones were found in the common duct. The patient was discharged in December, 1943, with bile draining from the wound. When the wound closed he developed chills, fever, and jaundice. He was readmitted in May, 1944. The sinus tract was followed to the common duct and according to the operative note a T tube was inserted into the common duct and through what was thought to be an inflammatory stricture into the duodenum. All bile continued to drain through the T tube. A roentgenogram with lipiodol injection, May 29, 1944, showed an obstruction of the common duct near the ampulla. This same observation was made in August, 1944, at which time I was asked to see him. During this time he had lost markedly in weight and strength. The appetite was poor, the stools acholic. All bile still drained through the T tube. There was marked edema of the ankles. After a number of blood and plasma transfusions, and refeeding of his own bile, plus vitamin K therapy, he was operated upon Aug. 10, 1944. The common duct was opened and explored. No stones could be found. No tumor mass could be felt, but a probe could not be forced through the lower end of the common duct into the duodenum. The diagnosis was not clear. The common duct was anastomosed to the duodenum, however, the T tube being left in place. It was removed three weeks later and the wound healed promptly. The jaundice cleared, the stools became acholic, and the patient did remarkably well. There were no chills or fever. He remained well until late February, 1945, when, following an automobile accident, he developed pains in the lower abdomen. He was admitted to the hospital March 5, 1945. A radiologic study of the upper gastroenteric tract showed that some barium entered the biliary tract, but left it completely within six hours. There was, however, a filling defect in the second portion of the duodenum suggestive of infiltration from a carcinoma of the pancreas. He soon started to vomit and was reoperated upon to relieve the duodenal obstruction. A large retroperitoneal mass was found with the duodenum stretched over it. A simple gastroenterostomy was performed. There was little relief obtained from this procedure. He continued to vomit irregularly, although there was no jaundice. He developed a severe right parotiditis, March 10, 1945. By March 21 he seemed better though he continued to have irregular fever and was mentally confused. He finally died April 19, 1945, apparently of pneumonia. Autopsy was not obtained.

In all four of these cases a direct anastomosis of the common bile duct to the intestine was made for the relief of jaundice or external biliary fistula. None of these patients showed signs of ascending biliary tract infection, although two of them were operated on and have remained well for approximately six years each. The other two lived only about one year each, dying of other causes. In each instance the common duct was opened by a transverse incision for exploration because it was believed that an anastomosis of the common duct to the intestine would be required, and it is easier and simpler to make such an anastomosis when the incision in the common duct is transverse to its long axis than when it is parallel to it. In each instance the anastomosis was made with continuous suture of catgut to give an accurate mucosa-to-mucosa approximation, reinforced by an anterior row of interrupted silk sutures. Chills and fever did not occur in any of these patients though two of them have had

choledocho-intestinal anastomosis for more than five years. The remaining two patients each lived less than one year after the anastomosis, both of them with carcinoma, and both dying of causes not directly related to the anastomosis. In these, it might be argued that a radical operation for cancer of the pancreas or ampulla should have been undertaken but it is my opinion that neither patient would have been a suitable risk for such an operation. In Case 3, the diagnosis of cancer was made and it was decided that radical operation should not be attempted. In Case 4, the malignant nature of the obstruction of the bile ducts was not recognized at the time the anastomosis of the bile duct to the intestine was made, but even if the carcinoma had been recognized no further procedure would have been done at that time because the patient was in such poor physiologic balance as the result of the prolonged loss of bile.

During the eight-year period 1938 through 1945, I operated upon nine patients with stricture of the bile duct following operative injury to the duct. None of these patients died, and all of them are well or in reasonable state of well-being at the present time. The last operation in this group was performed in February, 1945, so that the period of postoperative observation is more than two years in all cases. Various methods have been used in the repair of the duct, but in the most difficult cases direct anastomosis of the duct to the duodenum has been performed. A brief résumé of each case follows, the cases being listed chronologically.

CASE 1.—P. F., a white woman, aged 41 years, was admitted to the hospital Feb. 19, 1938, because of jaundice, anorexia, nausea and vomiting, and abdominal pain. According to her story she had been operated upon eight months previously for uterine bleeding. A hysterectomy was done, after which the surgeon palpated the gall bladder and felt stones in it. He therefore made an upper right rectus incision and removed the gall bladder. There was considerable drainage of bile for a while, but this ceased and the patient felt quite well for several months. Then she developed anorexia and nausea, and jaundice appeared and deepened progressively. At the time of admission she was intensely jaundiced, dehydrated, and emaciated. After suitable preparation she was operated upon Feb. 25, 1938. The upper end of the common duct was a dilated bulbous structure containing colorless, mucoid bile. The distal end of the duct was found imbedded in scar tissue with a defect of approximately 1 cm. between the two ends. An end-to-end anastomosis with interrupted silk sutures was done over a catheter, 4 inches of which was allowed to extend through the ampulla into the duodenum. There was considerable drainage of bile for nearly three weeks postoperatively, but it eventually ceased and she was discharged April 2, 1938.

She returned July 22, 1938, with recurrence of jaundice. The catheter was still in place. She was operated upon again July 27. Apparently the catheter, which had not been anchored, had slipped down until its upper end was below the anastomosis and a stricture had reformed. A reanastomosis was done in the same manner and the patient left the hospital in good condition Aug. 13, 1938. The catheter was passed a few days before she left the hospital.

She was readmitted one year later, July 4, 1939, with jaundice, pruritus, and vomiting which disappeared after medical management. She remained well until January, 1942, when she was again admitted with jaundice, itching, and anorexia. The wound was reopened Jan. 31, 1942, at which time the lower end of the common duct could not be found. Only a bulbous stump at the hilum of the liver representing the proximal stump could be located. This was opened, a vitallium tube was inserted and held with a purse-string suture, and the lower end of the tube was placed in the duodenum, the latter sutured to the scar tissue on the undersurface of the liver. There was no leakage of bile postoperatively and she was discharged Feb. 15, 1942.

She remained well for about one year, returning in April, 1943, with jaundice and pruritus. Roentgenograms showed that the vitallium tube had been passed. She improved and was discharged seven days later. In December, 1943, however, the jaundice became quite deep and I operated on her for the fourth time. When the lower surface of the liver was freed from the duodenum only a tiny opening was found. This was dilated and a vitallium tube re-inserted and anchored in place with several heavy silk sutures.

This tube also passed within a few months, however, and she returned to the hospital in July, 1944, with itching and mild jaundice. This time a T tube was inserted into the hepatic ducts, the lower end extending into the duodenum.

This tube was allowed to remain in place for thirty months, during which time she remained well. The tube was removed Jan. 29, 1947, and the patient has remained well up till July, 1947.

Comment.—This case, I believe, was not well managed. The most favorable opportunity was present at my first operation, and the method chosen at that time was not the most suitable. It might have succeeded had the catheter been anchored so that it could not slip below the anastomosis before healing had occurred. Better still would probably have been the use of a T tube with the side arm emerging from the duct above or below the line of anastomosis as recommended by Lahey.[4] With each succeeding operation, there has been more scar tissue until now there is a huge mass of scar and adhesions between the liver and duodenum. If still another operation is necessary, I believe the method of using a defunctioned loop of jejunum as described by Allen offers the best hope of a lasting cure.*

CASE 2.—J. S., a white man, aged 50 years, was admitted to the Cincinnati General Hospital, Jan. 10, 1939, with history that he had had attacks suggestive of cholecystic disease beginning in 1925, with one acute attack in 1930. Early in 1937 a cholecystectomy was performed for cholecystitis and cholelithiasis at another hospital. The operation was said to have gone smoothly. There was considerable drainage of bile from the wound after operation, but eventually it ceased, the wound healed, and the patient was discharged. The wound opened and closed several times thereafter. In November, 1937, about eight months postoperatively, jaundice appeared, and in January, 1938, the wound was reopened. The common duct, described as being very tiny in diameter, was probed (and drained?). Since the second operation the jaundice was intermittent, but more or less continuously present. The patient had lost about forty-five pounds in weight, from 160 to 115 pounds. There was no fever and no chills. The icteric index varied from 40 to 50 units. Cholesterol was 266 mg. per cent, and Van den Bergh positive direct and indirect. The patient left the General Hospital because he wished to be operated upon elsewhere. I operated upon him March 4, 1939. The common duct seemed to be completely obliterated in its mid-portion, though the proximal end was not distended. Fortunately the lower end was intact and it was opened and dilated. The scarred area was excised and the two ends approximated over a T tube. Lipiodol injected through the T tube in September, 1939, went directly into the duodenum and the ducts were not visualized. The tube was removed Sept. 25, 1939, and the patient has been without jaundice, chills or fever since. In November, 1944, a roentgenologic examination of the gastrointestinal tract made because of symptoms of peptic ulcer revealed some distortion of the second part of the duodenum. In April, 1947, he was admitted to the hospital for hematuria. At that time there were no symptoms or signs of disease of the biliary tract.

Comment.—Although there had been two previous operations it was fortunately possible to find the lower end of the common duct easily, and a successful result was obtained after simple reanastomosis over a T tube.

*In September, 1947, the patient developed signs of ascending cholangiitis without much jaundice. Allen's operation using a defunctioned loop of jejunum was performed and she was well up to Jan. 15, 1948.

CASE 3.—H. G., a white woman, 33 years of age, was admitted to the hospital Nov. 29, 1940, deeply jaundiced. She was operated upon for the first time April 11, 1939, a cholecystectomy being performed for a small contracted gall bladder containing stones. The common duct was palpated but not opened. The operation was said to have progressed smoothly. There was prolonged bile drainage and bile was still draining when she was discharged May 2, 1939. She was readmitted Aug. 7, 1939, because of intermittent drainage of bile and a history of becoming jaundiced when the fistula closed. She was reoperated upon Aug. 11, 1939, and according to the operative note the common duct was found to be small and contracted. It was opened and dilated with considerable difficulty because of scar tissue. A T tube was inserted. Postoperatively there was considerable drainage of bile through and around the tube. The patient was discharged Sept. 9, 1939, with the T tube in place, but clamped off. There is no record of when the T tube was removed, but about the middle of 1940 she developed chills, fever, diarrhea, and jaundice. I saw her for the first time in November, 1940, at which time she was deeply jaundiced, dehydrated, and emaciated. I operated upon her Dec. 3, 1940, and could find nothing but scar tissue where the common duct should have been. A bulbous structure containing colorless, mucoid bile was finally located in the hilum of the liver, which undoubtedly represented the proximal end of the common duct. A direct anastomosis was made to the duodenum without any tube. The operation was technically quite difficult because of the short proximal stump. She had a stormy postoperative course with drainage of considerable bile and duodenal contents, but eventually the wound healed and she was discharged Jan. 4, 1941.

She remained well for almost three years but was readmitted to the hospital Dec. 27, 1943, complaining of indigestion and intermittent jaundice of several months' duration. She was not jaundiced at this time, the icteric index being 10 units. She was reoperated upon Dec. 29, 1943, and a stricture found at the site of the previous anastomosis. This was dilated, and a vitallium tube inserted, one end into the hepatic duct, the other end into the duodenum. The operation was technically very simple. She had a smooth postoperative course with no bile drainage and has remained well since. She was last examined in June, 1947, at which time she was apparently entirely well 3½ years after the last operation.

Comment.—This patient was quite difficult to manage from a technical point of view at the time of the first operation in December, 1940. All of the common duct was gone except a tiny bulbous nubbin at the hilum of the liver so that anastomosis to the intestine was exceedingly difficult. In addition she was in a deplorable physical and physiologic state. The end result has been quite gratifying and there is reason to believe that she will remain well with a direct anastomosis of the duct to the duodenum over a vitallium tube.

CASE 4.—H. K. W., a white woman, aged 43 years, was admitted to the Cincinnati General Hospital, Dec. 8, 1941, complaining of chills and fever and intermittent jaundice. According to her story she developed symptoms of cholecystic disease in 1939, and was operated upon in 1940, at which time she had jaundice and acholic stools. At this time a cholecystectomy and common duct exploration were done. Following this operation she continued to have intermittent fever and jaundice; early in 1941 she was reoperated upon and an attempt made to anastomose the common duct to the duodenum. This was evidently unsuccessful because she entered the General Hospital in December, 1941, deeply jaundiced. I operated on her Dec. 12, 1941. No common duct could be found, and when the end of the hepatic duct was found in the hilum of the liver, it was discovered that the bulbous end was at the junction of the right and left hepatic ducts. A funnel-shaped vitallium tube was introduced so that the funnel-shaped end collected bile from both right and left ducts, and was held in place by a purse-string suture (this procedure is represented diagrammatically by Pearse[5]). The distal end of the tube was inserted into the duodenum and the latter structure was sutured to the scar tissue in the hilum of the liver. The postoperative course was smooth with practically no leakage of bile and the patient was discharged on the seventeenth day, Dec. 29, 1941. She

has remained entirely well since. She has moved to California and the last report I had was June 13, 1947. Her only complaint at that time was obesity and high blood pressure. A recent roentgenogram had showed that the tube was still in place.

Comment.—This patient has remained well for 5½ years after direct anastomosis of the hepatic duct to the duodenum over a vitallium tube, and is presumably cured.

CASE 5.—V. U., a white woman, aged 34 years, was admitted to the Cincinnati General Hospital March 13, 1941, with a diagnosis of chronic cholecystitis and cholelithiasis. She was operated upon by the resident surgeon March 28, 1941. At the time of division of the cystic duct for removal of the gall bladder it was recognized that the common duct had also been divided. This was immediately anastomosed over a T tube, the side arm of which was allowed to come out through the stump of the cystic duct. The tube was removed May 3, 1941. The patient remained well for about six or eight months and then developed intermittent chills, fever, and jaundice.

She was readmitted April 27, 1942, moderately jaundiced. I operated on her May 15, 1942, at which time the two ends of the common duct were found and anastomosed over a vitallium tube. The postoperative course was smooth and she remained well until early in 1946, when she developed signs and symptoms of biliary cirrhosis. She has had several admissions to the hospital on the Medical Service. The liver function tests have shown moderate impairment of liver function and a diagnosis of biliary cirrhosis has been made. She was last seen in May, 1947, at which time she was feeling quite well, five years after operation.

Comment.—This case represents a good result obtained by end-to-end suture of the duct over a vitallium tube. One would have expected a good result from the first anatomosis over a T tube. It shows that one cannot predict with assurance what may be expected to happen after any given procedure.

CASE 6.—K. D., a white woman, aged 32 years, was admitted Oct. 14, 1942, because of intense jaundice and itching. About ten weeks earlier the patient had had a cholecystectomy performed at another hospital. At the time of operation the surgeon was apparently somewhat confused about the relationship of the ducts but finally convinced himself that everything was all right. Jaundice developed rapidly after operation, however, and soon became quite marked. On October 15 the icteric index was 176 units. At operation, Oct. 17, 1943, no common duct could be found except a small bulbous area at the hilum of the liver, at the junction of the right and left hepatic ducts. This was opened and a funnel-shaped vitallium tube inserted as in Case 4, the lower end being inserted into the duodenum, and this structure then sutured to the scar tissue at the hilum of the liver. The postoperative course was uneventful, the jaundice decreased rapidly, and the patient was discharged on Nov. 4, 1942. About ten days after discharge she had a chill and fever, which rapidly subsided.

She was readmitted about one year later, Jan. 5, 1944, with pain, nausea, jaundice, and itching which had been gradually increasing for several months. Roentgenograms showed the tube in place. She was reoperated upon Jan. 8, 1944. From the outside the anastomosis looked all right, but it was taken down and the tube removed. The latter was found to be filled solidly with puttylike biliary concretion. It was carefully cleansed, resterilized, and reinserted. This was accomplished with some difficulty as the funnel-shaped end did not seem to go freely into the hepatic end of the duct, and subsequent events make me wonder whether a small amount of duct were invaginated with the tube. The lower end of the tube was replaced in the duodenum. The operation was simple from a technical point of view. The postoperative convalescence was smooth and the patient was discharged Jan. 22, 1944, the fourteenth day.

She remained well only a short while and was readmitted May 27, 1944, again with jaundice and itching. She was operated upon May 30, 1944. There were many adhesions and a great deal of scarring. On removing the vitallium tube, a great deal of granulation tissue was found filling the lower end of the common duct proximal to the tube. This was curetted, the duct washed and dilated, and a T tube inserted into it, the other end placed in the duodenum and a tight closure made around the side arm of the tube which was brought out through the wound. The postoperative convalescence was uneventful and the patient was discharged Jan. 17, 1944. It was planned to leave the T tube in place for a period of months, possibly one year or longer.

In the spring of 1945 at a routine follow-up examination the patient announced that she was several months pregnant. After some consultation a therapeutic abortion was recommended, but the patient refused to have the procedure done. The pregnancy was without incident and the baby was born Dec. 30, 1945. During this period the T tube was kept clamped off continuously except for a period once a month when it was opened temporarily. On several occasions there was irritation of the skin around the tube. This was treated with zinc peroxide ointment, which had to be discontinued because it caused deterioration of the rubber. At one time it was doubtful whether the tube would last throughout the pregnancy. It was amazing how far down the tract became epithelized by growth from the abdominal skin. It was my hope that the duct was also becoming completely epithelized. About three weeks after termination of the pregnancy, on Jan. 21, 1946, the tube was removed. The tract continued to drain bile-stained duodenal contents except when sealed off with a gauze or cotton pack held in place by adhesive, and the patient had to change this dressing every three or four days. She has had two bouts of chills, fever, and jaundice, one requiring hospital care in April, 1947. This subsided promptly following chemotherapy, was probably due to cholangiitis, and suggests to me that the stricture may be recurring. According to more recent reports, however, she has been well for the past few months up until late August, 1947.

Comment.—It is unfortunate that in this instance the vitallium tube used in the first operation became plugged with bile pigments, for if it had not I believe a good result would have been attained. Many others who have used vitallium tubes have had the experience of having them become plugged in this fashion. The reason for the occurrence of this deposition of pigment is obscure, but is probably related to the chemical constitution of the bile. At the present time there is no known method of preventing it with certainty, and for this reason many surgeons are abandoning the use of vitallium tubes in repairing the bile ducts, and relying on the older method of some sort of removable tube.

This patient's trouble after the second operation in which the vitallium tube was removed, cleansed, and replaced was probably due to improper replacement of the tube in the proximal end of the duct, due to my unwillingness to cut the duct sufficiently widely to allow the insertion of the funnel-shaped end of the tube. I still do not feel satisfied that this patient will remain well and as in Case 1, if further operative intervention is necessary, I believe that the procedure described by Allen should be employed.

CASE 7.—P. D., a white woman, aged 47 years, was admitted Nov. 9, 1943, because of a complete external biliary fistula. June 19, 1943, she had had a cholecystectomy for acute cholecystitis. Apparently she had a very stormy postoperative course, and was reoperated upon July 10, although it is not clear just what was done. Eventually she recovered, but with a complete biliary fistula.

Lipiodol injection through the fistula showed a tortuous tract up to the hilum of the liver and then outlined a dilated biliary tree. At operation Nov. 13, 1944, a catheter was

inserted into the fistula as a guide and an attempt made to follow it to the common duct. The catheter slipped out, however, and the tract became smaller and smaller till it finally was lost. In spite of what was thought to have been adequate preparation with vitamin K and blood transfusions, there was continuous oozing from the wound, which was very troublesome. It seemed impossible to find the upper end of the common or hepatic ducts. Since there had been little or no obstruction, the ducts proximally were not greatly dilated nor was there much bile dammed in them. Occasionally there was a small spurt or ooze of bile, but every time the area was searched for the duct, only excessive bleeding occurred. Finally without clear visualization a vitallium tube was inserted into what was thought to be the proximal end of the duct. The other end was placed in the duodenum since the lower end of the duct could not be found. The result was unsatisfactory, and the patient was discharged Nov. 29, 1943, with some bile still draining from the wound but some reaching the intestine. The fistula closed in a few weeks but the patient then developed chills, fever, pain, and jaundice.

She returned to the hospital March 23, 1944. At this time she was moderately jaundiced, the icteric index being 25 units. She was reoperated upon March 30, 1944, and again the proximal end of the duct could not be clearly visualized. After a long time had been spent searching for the duct and when the patient's condition was becoming serious from loss of blood, a T tube was placed in what was thought to be the proximal end of the duct, the lower end of the tube being inserted into the duodenum. Bile drained around, but not through, the tube so the latter was removed and the patient discharged April 16, 1944, with a complete external biliary fistula. This fistula also closed, but soon thereafter chills, fever, malaise, and jaundice recurred.

She returned again Oct. 17, 1944, and was operated upon October 20. This time by carefully peeling the scar from the undersurface of the liver by sharp dissection, it was possible to isolate the proximal hepatic duct. A T tube was inserted into the duct, the lower end being inserted into the duodenum. It looked as though this were going to succeed and the patient seemed to be progressing satisfactorily though slowly. There was some drainage around the tube, but this gradually decreased. However, our troubles were not over. Just before the patient was discharged from the hospital, a lipiodol injection through the tube was done. To our surprise this showed that the lipiodol entered the colon as well as the duodenum and bile ducts. Barium by mouth was given and showed a large duodenocolic fistula. Just how this fistula developed remains unclear. It may have been due to an injury to the colon in freeing it which remained unrecognized at the time of operation. It is possible that I mistook colon for duodenum and inserted the lower arm of the T tube into it, though this seems unlikely for in freeing the duodenum from the liver the remains of the anastomosis of the bile ducts to it still remained in the form of a tiny hole. The fact that practically everything the patient ate went directly from the duodenum to the colon was explained to her, but she nevertheless insisted on leaving the hospital without further operation because she felt well.

She returned Dec. 29, 1944, however, because of diarrhea, vomiting, and loss of weight. There had been no chills or fever and only slight jaundice. On Dec. 30, 1944, she was reoperated upon, the colon freed from the duodenum, and the opening in the colon closed. The bile ducts were anastomosed to the duodenum over a T tube. In a few days it was obvious that this suture had not held, the T tube fell out, and there was profuse drainage of bile and duodenal contents. Fortunately the closure of the colon held, and since the operation had been performed practically extraperitoneally there was no peritoneal reaction and the abdominal wound held. On Jan. 6, 1945, a jejunostomy was done for feeding. The abdominal wound was kept as dry as possible with continuous suction. In a few days the wound began to heal, and she was finally discharged Feb. 7, 1947, eating normally, with all wounds healed and in reasonably good condition.

Since then her progress has been only fair. She has had some attacks of pain in the upper abdomen, and bouts of fever, chills and jaundice, so that I think certainly she will have further trouble. At last report in the spring of 1947 she was getting along fairly well.

Comment.—In this case the poor result was, I believe, largely due to poor operative technique. It was the only instance I have met in which it was impossible clearly to identify the duct proximally. In spite of the fact that the duct had been opened, there was no continuous flow of bile to identify it, and every attempt to locate it led to bleeding so brisk as to obscure the field. At the third attempt, the scar tissue was stripped off the undersurface of the liver up into the hilum in a broad sheet by sharp dissection until the duct was located. The duodenocolic fistula was probably also a technical error, although injury or opening into the colon was unrecognized at the time.

CASE 8.—A. L., a white woman, aged 22 years, was admitted Feb. 18, 1944. This patient had had a cholecystectomy performed elsewhere in October, 1942. The operation was said to have progressed smoothly. Postoperatively, however, there was considerable difficulty. The patient developed a large mass in the right upper quadrant, which was drained after some days and proved to be a large intra-abdominal collection of bile. Following this procedure an external biliary fistula developed, which drained only a moderate amount of bile. Lipiodol injection in January, 1943, showed that this fistula communicated with the hepatic flexure of the colon. At that time I recommended operation, but the patient was feeling well and refused to have anything done. The fistula closed and she got along fairly well for some time, but then over a period of six to nine months she developed attacks of fever, pain in the right upper abdomen, and moderate jaundice. Finally she began to lose weight and strength and agreed to operation.

She was operated on February 21, 1944. There were numerous adhesions, and a small fistulous tract only one millimeter or so in diameter extended from the common bile duct over the duodenum to the colon. This was excised and the distal end inverted into the colon. The proximal end of the duct was thick, but not much dilated. The distal collapsed end was found, with a defect of 1 to 2 cm. between the two ends. By mobilization, the two ends could be brought together and an end-to-end suture of interrupted fine silk was done over a vitallium tube. The postoperative course was smooth and uneventful and the patient was discharged March 4, 1944. She has remained entirely well since. She went through a pregnancy the following year, the baby being born by cesarean section Sept. 8, 1945. She was last heard from in June, 1947, 3½ years after operation, at which time she said her health was splendid and the only complaint was the gain in weight.

Comment.—This is the type of good result that can be expected when the most desirable method can be used, namely, direct anastomosis of the ducts over a tube.

CASE 9.—A. T., a colored woman, aged 45 years, was admitted to the Cincinnati General Hospital Feb. 9, 1945, because of an external biliary fistula and jaundice. She had had a cholecystectomy elsewhere for cholecystitis and cholelithiasis on Dec. 16, 1944. She developed jaundice a week or ten days after operation, which became progressively worse. Jan. 29, 1945, she was reoperated upon, at which time a dilated common duct was found apparently after some difficulty. The surgeon inserted a catheter into the duct, because he believed the patient's condition precluded further surgery at the time. On February 9 she was transferred to the General Hospital and I operated upon her ten days later, Feb. 19, 1945. The operation was difficult from the very beginning. The fresh adhesions and scar tissue were extremely vascular so that it was impossible to keep a dry field. By following down the undersurface of the liver into the hilum the proximal end of the common duct was found, but the distal end could not be located. A T tube was inserted into the proximal duct, the other arm put into the duodenum through a stab wound, and the duodenum sutured to the common duct. Biopsy of the liver showed focal necrosis. The postoperative course was uneventful and the patient was discharged March 12, 1945, with the tube in place but clamped off.

Lipiodol injection shortly before discharge showed that the material entered the duodenum and practically none entered the ducts. The T tube was allowed to remain in place for about eighteen months and was removed in September, 1946. The external wound healed in about six weeks after removal of the tube and when last seen in June, 1947, the patient was apparently entirely well.

DISCUSSION

Four of these nine patients had direct anastomosis of the two ends of the duct and this method proved fairly successful. In Case 1 stricture recurred after two attempts by this method, and anastomosis of bile ducts to the duodenum was then used, also with only a fair result. In Cases 2 and 8 the result was satisfactory after one attempt, while in Case 5 it was successful after a second trial. In five cases, Cases 3, 4, 6, 7, and 9, the lower end of the common duct was not found, and in Case 1 after the first two operations it was not found, so that ultimately in these six cases anastomosis of the common duct to the duodenum was used. This procedure was apparently entirely successful in three patients, and at least fairly successful in the remaining three, for all of them are alive and reasonably well from 2½ to 5½ years after the last operation. I have learned, however, that even after two to three years one cannot call a satisfactory result a cure.

Patients with stricture or absence of the common duct require a great deal of painstaking attention in the preoperative preparation, in the operative technique, and in postoperative care. Usually they are in poor physiologic balance, and blood and plasma should be used freely in preparing them for operation. Vitamin K parenterally in large doses should be given. If the patient can tolerate it, the diet should be rich in carbohydrate and protein. If the patient is unable to eat well, these substances should be given parenterally. If the patient has an external biliary fistula, collection of the bile and refeeding either by mouth or with the use of a stomach tube is of great help, otherwise a commercial form of bile salts should be given by mouth. A Levine tube for continuous gastric suction after operation should be in place in the stomach before the operation is started. It is also probably wise to prepare the patient with chemotherapy for one or two days before operation, and to continue this treatment through the first few postoperative days, although this method was not used in most of my patients.

One or two hints about the operative technique should be emphasized. The most important thing is to find the proximal end of the common duct. In order to do this it is helpful, after preliminary exposure has been made, to locate the undersurface of the right lobe of the liver, and follow down along it with sharp dissection, always staying as close as possible to the liver without actually incising it, approaching the region of the hepatic ducts in the hilum from the front and a little to the right side. If there is more or less complete obstruction, the bulbous end of the common duct will appear through the scar tissue as a bluish-tinged cystlike structure, and this should be exposed, also by sharp dissection, to its most distal or dependent part before it is opened. To find the lower end of the duct may be even more difficult. Cattell stated that it can

almost always be found by mobilizing the duodenum and reflecting it to the left to pick up the retroduodenal position of the duct, which is usually below the level of scar formation. I have not had occasion to use this method, but recently watched one of my associates do so. After he had spent considerable time in thus isolating the lower end, he found that it was impossible to free it sufficiently to allow it to reach up to the very short proximal stump which was high up in the hilum of the liver. I have usually contented myself in making a reasonably careful search for the lower end of the common duct but if it has not been found crainiad to the upper curve of the duodenum, I have abandoned the search and anastomosed the proximal end to the duodenum. In view of the excellent results reported by Cattell, I now wonder if I have been sufficiently diligent in searching for the distal end. As a result of the trouble experienced with vitallium tubes, namely, difficulty in keeping them in place for a sufficient period of time, and possible danger of their becoming plugged with concretions of biliary origin, I believe that in the future I shall use removable tubes of one sort or another, probably either a T tube or fenestrated catheter. Unless technical difficulties prevent, I am sure that every effort should be made to produce a mucosa-to-mucosa suture between bile duct and intestinal epithelium. It is better, I believe, to have a little mucosal eversion and some bile leakage, than to have a tight serosal approximation, so that there is no leakage of bile in the immediate postoperative period, but possibly an anastomosis which is partly lined by serosa and which will later contract if epithelization does not occur promptly. Finally, if it is impossible to anastomose duct-to-duct, and duct-to-intestine anastomosis becomes necessary, while I agree that it is theoretically better to use a defunctioned loop than a direct anastomosis, I still believe that the simpler technical procedure of direct anastomosis may be accepted for use in greatly debilitated or poor-risk patients because of the lessened operative hazard. In this group of patients it has been fairly satisfactory and has not been followed by evidence of ascending infection into the liver except in those cases in which stricture has recurred.

SUMMARY AND CONCLUSIONS

Thirteen cases of anastomosis of the common duct to the intestine or repair of a stricture of the common duct are reported, all of them my own personal cases. In the first four, a relatively normal duct was used in making the anastomosis. In the remaining nine cases a duct injured at a previous operation was present.

There were no operative deaths in the thirteen cases though two patients, both of whom had cancer, died subsequently of causes not directly related to the operative procedure on the common duct.

In ten of the thirteen cases, the last operation performed was some type of anastomosis of the hepatic or common duct to the duodenum without the use of a defunctionated loop, and in seven of these the result has been entirely satisfactory. Two of these seven patients died within one year of operation, but the others are well 2½ to 6 years after operation. Three patients in this

group of ten have been reasonably well 2⅓ to 3½ years after operation, but all of them have had one or more attacks of chills, fever, and jaundice and may require further operation.

In three of the thirteen cases a satisfactory result was obtained by end-to-end suture of the duct, 3½, 5, and 8 years after operation.

Two patients have gone through normal pregnancies after operation.

Certain technical details such as the importance of mucosa-to-mucosa suture, and the methods of finding the proximal end of the duct, have been discussed. While vitallium tubes have functioned successfully in a number of instances, in others they have not remained in situ, and in one case the tube became plugged with concretions, necessitating its removal.

As a result of this experience, it is my opinion that:

1. End-to-end suture of the duct is the most desirable method, but frequently it is technically impossible to achieve.

2. Mucosa-to-mucosa approximation should be a most important consideration, and should be attained if possible regardless of the method of anastomosis used.

3. While ascending infection is a hazard in anastomosis of the duct to the duodenum, it nevertheless is followed by a successful result in a sufficiently large proportion of cases, so that it should not be wholly abandoned as a method. At least it may be used as the first method attempted in patients who have a great deal of scarring and adhesions, and who are debilitated as a result of prolonged obstruction of the ducts. It is relatively simple, and in this small group of cases was attended by no operative mortality.

4. Removable tubes probably are more suitable than vitallium tubes in preserving patency of the anastomosis till epithelization has occurred.

5. No standard method is applicable to all cases but each should be treated as seems indicated in that particular case.

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THE PROBLEM OF GASTRIC CANCER IN A UNIVERSITY HOSPITAL

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IT WAS my privilege to be the first University of Cincinnati graduate to train for six years under George J. Heuer after he came to Cincinnati as professor of surgery. That training enabled me to come to the University of California in July, 1930, to start a similar type of resident training program. It is most fitting that Dr. Heuer's residents should commemorate his retirement with a volume such as this.

The fact that cancer of the stomach is curable should be more widely emphasized. Physicians as well as laymen display an unenlightened attitude toward this dread disease. The only known cure at the present time is radical removal of the malignant process. It is granted that cures are few, but every patient should be given the chance, small though it is, for a cure. Unless distant metastases are unequivocally proved, every patient with a diagnosis of cancer of the stomach should have an exploratory operation to determine whether the lesion is resectable.

During the past seventeen years 540 patients with carcinoma of the stomach have been seen at the University of California Hospital. Out of this whole group 69.2 per cent were subjected to surgery, and gastric resection was accomplished in 34.4 per cent of cases (Table I). One must realize that most of these cases occur in the older age group in which the natural hazards of surgery and anesthesia are increased. In a well-recognized hospital where the personnel are interested and adequately trained to accomplish such drastic surgery, the mortality rate can be kept within a reasonable limit. A tremendous improvement in anesthesia during the past few years has made it possible for many of these patients to be carried through successful surgery. Many of the elderly patients are operated upon under local anesthesia. It will be noted in Table I that during the past five years the operative mortality has decreased from 22.2 to 11.9 per cent.

The only hope for increasing the number of cures is by earlier recognition of the disease and early operation. Of those patients operated upon, 49.7 per cent had a resectable lesion (Table II). The resectability rate calculated on all patients in the series was 34.4 per cent. It is in this 34 per cent that we may expect our five-year survivals or cures. Entirely too many cases come to attention at the clinic in such an advanced stage that they are already beyond help. Out of this whole group, 30.7 per cent of patients had an inoperable lesion and received only supportive medical treatment. In 65.5 per cent of all cases the lesion was not resectable.

TABLE I. FIVE HUNDRED FORTY CASES GASTRIC CARCINOMA, 1930 TO 1947—OPERATIVE MORTALITY

	NUMBER OF CASES		MORTALITY 1930 TO 1941 (PER CENT)	MORTALITY 1942 TO 1947 (PER CENT)
	NUMBER	PER CENT		
Gastric resection	186	34.4	20.6	11.7
Palliative surgery	79	14.6	23.7	10.0
Exploratory laparotomy	109	20.1	23.2	13.2
Total surgery	374	69.2	22.2	11.9
No treatment	166	30.7		
Total	540	100	22.2	11.9

It is quite apparent from Table III that the most favorable location of a gastric lesion is the pyloric end of the stomach. Perhaps this is due to the fact that symptoms of obstruction occur earlier and are called to the attention of both the patient and the doctor. Of patients with carcinoma at the pyloric end of the stomach who were operated upon over five years ago, 18.9 per cent lived five years or longer. Thirty patients in this group who were operated upon less than five years ago are still alive and well.

TABLE II. FIVE HUNDRED FORTY CASES GASTRIC CARCINOMA, 1930 TO 1947—RESECTABILITY

	PER CENT
Resectability rate (calculated on all patients)	34.4
Resectability rate (calculated on patients operated upon)	49.7
Not resectable	65.5
Inoperable (only medical treatment)	30.7

During this same seventeen-year period, gastric resection was done in seven cases of sarcoma of the stomach. Two of these patients lived well over five years, one dying at six years of intercurrent disease and one being still alive nine years after the resection.

TABLE III. FIVE HUNDRED FORTY CASES GASTRIC CARCINOMA, 1930 TO 1947—SURVIVAL FOLLOWING GASTRIC RESECTION

LOCATION OF TUMOR	TOTAL CASES	NUMBER RESECTED		OPERATIVE MORTALITY (PER CENT)	LIVED 5 YR. OR LONGER		LIVING LESS THAN 5 YR.	DIED LESS THAN 5 YR.
		NO.	PER CENT		NO.	PER CENT		
Cardia	113	24	21.2	33.3	0		2	22
Body	63	17	27.0	11.7	0		4	13
Pyloric end	259	137	52.9	13.8	14	18.9	30	93
Diffuse	105	8	7.6	12.5	0		2	6
Total	540	186	34.4	16.1	14	7.5	38	134

There is still too much delay between the time of suspicion of a gastric lesion and the time of exploratory laparotomy. Much of this delay is caused by the physicians themselves, and some is due to procrastination on the part of the patient.

To illustrate the delay as we see it in a teaching hospital to which patients are referred from all parts of the state, I should like to describe briefly the history of a woman who was seen here in April, 1946.

CASE REPORT

Except for an occasional spell of high blood pressure, this 74-year-old widow had been well until June, 1945, when she noticed increasing weakness with some accompanying loss of appetite. Her local physician told her it was her "nerves," and made no examination. In December, 1945, the patient felt extremely weak, and at about this time she began to notice distress in the upper mid-epigastrium. She described this as a "hurting" sensation which was very deep; it was not sharp nor a real pain. Another local physician made a hemoglobin determination and told her she had anemia. She was taken to a hospital for two weeks and was given five liver shots, but no special diet. No x-ray studies nor further laboratory tests were done. In January, 1946, the patient had an attack of severe nausea and vomiting. The vomitus was whitish and contained no blood nor coffee-ground material. She was kept in the hospital again for several days on a fluid, food-free regimen. No x-ray studies were done.

In March, 1946, the patient came to California still feeling extremely weak and bothered by epigastric distress, which might come on at any time but was most marked after she had eaten any spicy foods. In April, 1946, the first x-ray examination was made and a diagnosis of carcinoma of the stomach was made. The doctor who ordered the roentgenograms told the family that their mother had a carcinoma of the stomach which was inoperable, and that nothing could be done about it but to take her home and let her die. The son, however, asked to have his mother sent to the University of California Hospital, where she was admitted on April 20, 1946. The positive findings were a blood pressure of 160/80, a hemoglobin of 46 per cent, a red blood cell count of 2,870,000, and a white blood cell count of 4,100. Gastric analysis showed no free hydrochloric acid. X-ray examination showed a filling defect in the pyloric end of the stomach.

This patient was operated upon on April 27, 1946, under local anesthesia. A carcinoma of the pyloric end of the stomach was found, and a subtotal gastric resection was done without difficulty. There was no evidence of local spread of the carcinoma, and the lymph nodes on the greater and lesser curvature were not involved. The liver was free from metastases. When last seen in July, 1947, this patient had no complaints referable to the stomach. She had regained her strength, the blood count was normal, and she was eating without difficulty.

Delays such as are illustrated by this case history are deplorable, and it seems to me that there must be something wrong with the teaching in our medical schools throughout the country for physicians at large to have such a fatalistic attitude toward carcinoma of the stomach. To be certain, it has been only one year since this patient was operated upon, but is not that one year of comfort worth something? It is my feeling that this woman, who is now 75 years of age, has a good chance of attaining her life expectancy and of dying from the cardiac disease, rather than from a recurrent malignancy.

Granting that the percentage of five-year survivals is extremely small, since there is no other known treatment for carcinoma of the stomach no patient should be denied this small chance for a cure. With the improvement in recent years in operative technique and in anesthesia, and the decrease in the operative mortality rate, I feel we are justified in doing everything we can to bring these patients to surgery earlier while there is still a possibility that the lesion may be a resectable one.

LYMPHOSARCOMA OF THE GASTROINTESTINAL TRACT

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LYMPHOSARCOMA involving the alimentary tract is admittedly a rare disease, and only a few such sarcomas may be seen during the entire clinical experience of one surgeon. Nevertheless, its role as a masquerading lesion and its different prognosis and management bids us re-evaluate our present data regarding diagnosis and treatment. This paper reports a case of lymphosarcoma of the duodenum presenting as perforated peptic ulcer. A brief review of the general problem of gastrointestinal lymphosarcoma is given, with a consideration of incidence, location of involvement, similarity to other conditions, diagnosis, and surgical management.

INCIDENCE

The incidence of lymphosarcoma of the gastrointestinal tract is extremely low. Taking the stomach alone as an indication, this lesion comprises approximately one-half of all sarcomas of this organ, which form only 1 to 2 per cent of all gastric neoplasms.[1, 2] While its occurrence rate in the small gut may be somewhat higher, the over-all low percentage of neoplastic involvement of this region will make it even more rare in this location. While carcinoma is found more frequently in the large intestine, sarcoma may occur in the small and large intestine and rectum.

PATHOLOGY

Sarcoma of the gastrointestinal tract may occur in three forms: spindle-cell type, generally arising from muscle, slow of growth and metastasizing late; round- or mixed-cell sarcomas, an ill-defined group; and lymphosarcoma, which is the most important of the three. This last group may be further divided into malignant lymphocytoma, giant follicular lymphoblastoma, and the more common reticulum-cell lymphosarcoma.[3]

In lymphocytoma, the normal architecture is replaced by mature lymphocytes, and the picture resembles that seen in lymphatic leucemia, the differentiation being made by examination of the blood. This condition may terminate as lymphatic leucemia. Follicular lymphoblastoma or giant follicle lymphoma is an intermediate type in which the follicles are very large and present an increase in both lymphoblasts and reticulum cells. It has a tendency to revert to either true lymphocytoma or reticulum-cell sarcoma. It is of low malignancy and is extremely radiosensitive. The third type with the reticulum cell as its unit is included with the lymphosarcomas, even though the tumor arises from reticulum cells in the node or follicle. Microscopically, it is characteristic, revealing an abundance of reticulum formation, in contrast to the widely separated, sparse original reticulum demonstrated in the other two types. It is a highly malignant disease, with an average duration of less than two years.

Grossly, the pathologic findings depend largely upon the original site of tumor growth and the manner in which it spreads. In the intestine, the growth may be polypoid or more commonly intramural. In the former instance, the projection inward of the mass may give rise to partial obstruction or serve as the leading point of an intussusception or volvulus.[4] Polypoid growths may be multiple, whereas the annular type is usually single, and may be localized or extensive enough to involve a considerable segment of bowel. It is the annular, intramural growth that affords the most variables. As the tumor spreads through the bowel layers, the muscular and submucosal layers are replaced, and the growth comes to lie beneath the serosa, which is rarely penetrated. Three processes may then take place: the submucosal portion of the tumor may break through, ulcerate, and undergo partial destruction and ulceration; there may be a gradual dilatation of the gut as the nervous and muscular layers are replaced by the growth, giving the bowel the appearance of a thick-walled hose pipe," an appearance which is said to be diagnostic (excluding tuberculosis); and last, there may be an actual stenosis of the gut with the narrowed lumen causing partial intestinal obstruction.[2]

SITES OF INVOLVEMENT

The relative incidence of involvement of different portions of the gastrointestinal tract has been reported by a number of writers.[2, 5-9] In their review of their own and other statistics, Ullman and Abeshouse concluded that lymphosarcoma is more frequent in the small than in the large intestine, not excluding the rectum. The small intestine was the site of the lesion in seventy-seven cases, the large intestine (including the cecum) in thirty-two cases, and the ileocecal region in eight cases. The most common location for the tumor was the ileum, and next in order the jejunum, then the cecum. However, when the entire alimentary canal is considered, the stomach is the most frequent site. Some authors (Libman in particular[10]) found the duodenum involved as frequently as the ileum. It may be concluded, therefore, that lymphosarcoma may occur anywhere along the gastrointestinal tract, and that next to the stomach, the ileum is the most frequently involved.

DIAGNOSIS

The diagnosis of lymphosarcoma revolves about the presenting symptoms and altered physiology. The provisional diagnosis is almost always the most common one for the particular group of signs and symptoms. The differential diagnosis, however, is usually very difficult and may indeed be impossible without laparotomy. The possibility of lymphosarcoma may be suggested by several factors: The age of the patient is significant, lymphosarcoma being suspected in the young, carcinoma in the group past 40 years of age. Carcinoma is essentially an obstructive lesion, of relatively slow growth, whereas lymphosarcoma progresses rapidly, and rarely gives rise to a complete obstruction. A more rapid downhill course is to be expected with lymphosarcoma, cachexia and marked toxemia being quite common. Melena is occasionally seen when the lesion is

gastric, but in the intestines is more commonly indicative of carcinoma. With gastric and duodenal lymphosarcoma, dypepsia and ulcerlike symptoms may predominate. Last, the marked radiosensitivity of lymphosarcoma will also serve to differentiate it from carcinoma. It is upon this fact that Cheever, in 1932, stated the rationale for laparotomy in all cases of an abdominal mass suspected of being neoplastic, in the hope of finding a certain percentage of lymphosarcomas which might be given radiation therapy and offer the patient a considerably longer period of survival.

SYMPTOMATOLOGY

Lymphosarcoma may present first by almost any symptom referable to the gastrointestinal tract. A review of case reports of this lesion will exemplify the diverse symptomatology and chief complaints of patients with this disease. The onset may be insidious, with weight loss, anorexia, fatigue, and other general constitutional symptoms, or may be ushered in by an acute abdominal catastrophe, such as perforation or massive hemorrhage.[19, 20]

Archer and Cooper stated that in lymphosarcoma of the stomach, the symptoms are usually those of nonobstructive peptic ulcer.[11] Hematemesis and melena are rare but may occur. Involvement of the duodenum may give rise to the same symptoms as these or may be obstructive, depending upon the character of the growth, whether intraluminal, intramural, or infiltrative.[21]

In the small intestines, the symptomatology again depends primarily upon the characteristics of the growth. Polypoid tumors may serve as the starting point for intussusceptions and present acute obstruction, as reported by Cutler and associates.[4] They may also give rise to low grade obstruction from chronic intussusceptions. Even if obstruction is not the primary factor, most patients with this lesion in the small bowel will have nausea, vomiting, and bouts of abdominal pain.[12] Gross blood and even tarry stools may occasionally be seen. Speese[13] pointed out that the symptoms might be slight at the onset, but would later develop into pain, associated nausea, anorexia, vomiting, constipation, distention, and perhaps a palpable abdominal tumor. He classified lymphosarcomas of the bowel in seven groups, depending upon the presenting signs and symptoms: latent tumor, found at necropsy; tumors discovered first by general abdominal distention and palpable tumor (these being rather rare); the acute tumors which begin with intussusception, rapid obstruction, or perforation; those which present the picture of tuberculous peritonitis; tumors in which jaundice is the first symptom; tumors which simulate ovarian cysts; and last, those which mimic appendicitis. Involvement of the cecum is manifest in the majority of cases by cramplike abdominal pain, palpable tumor, and loss of weight.[12] Diarrhea and melena are infrequent. Tumors of the colon distal to the cecum are relatively more rare and present much the same picture as cecal lymphosarcoma. Location in the rectum is revealed by blood in the stool in the majority of instances, and in almost every case the tumor can be reached by the examining finger.

The involvement of superficial lymph nodes is occasionally seen and, in the presence of a palpable abdominal tumor or one demonstrable roentgenographically, strongly suggests the diagnosis of lymphosarcoma.[2] Palpable inguinal nodes are present in about one-half the cases of lymphosarcoma of the rectum.

The hematologic picture is not diagnostic in this condition.[7] In certain cases, in which the tumor is a malignant lymphocytoma, the blood may show the typical findings of lymphatic leucemia. This may occur with other forms of lymphosarcoma, but not nearly as frequently.

ROENTGENOLOGIC FINDINGS

Roentgenologic examination may aid considerably in the diagnosis of lymphosarcoma. In the stomach, tumefaction and ulceration may be evident, riving rise to large ulcer craters similar to carcinoma.[11] Large rugae may be visualized along with separation of the individual folds. Duodenal involvement may present the deformity characteristically seen with ulcer, with evident spasm or ulceration or both.[14] Some lymphosarcomas of the stomach may present nothing diagnostic in the roentgenographic appearance of the stomach and peristalsis may not be interfered with as much as in the presence of carcinoma.[15]

Intestinal lymphosarcoma will give varied roentgenographic findings. Obstruction may predominate and distention of intestinal loops be seen. Intussusceptions may be demonstrated by contrast media, provided they occur low enough to be reached by barium enema, that is, colocolic and ileocolic. Polypoid tumors may be seen as filling defects or show chronic obstruction with motility series. Commonly seen is a partial stenosis of intestine, with proximal dilatation.[22] Less frequently one sees a dilatation of bowel in the region of tumor, said by many authors to occur more often than stenosis and to be diagnostic for lymphosarcoma. Rowe and Neely[16] and Greenfield[17] have stated that the typical roentgenographic picture of lymphosarcoma of the small bowel may be obtained by "stasis ray" of the small intestine, and they feel that the more frequent use of this method will lead to earlier diagnoses and demonstration of the lesion.

CASE REPORT

R. W. S., a 40-year-old man, was admitted to the hospital on Sept. 9, 1939, in acute distress and complaining of severe abdominal pain, of seven hours' duration. This began suddenly as epigastric distress, and rapidly became generalized, steady and excruciating. There had been no nausea, vomiting, or other gastrointestinal symptoms. No history of previous similar symptoms referable to the abdomen was elicited; appetite had been good, with only occasional indigestion, relieved by self-medication. Remainder of past history was negative.

Examination showed temperature, 97.0° F.; pulse, 84; respirations, 20; blood pressure, 150/85. The patient was a well-developed and nourished adult man in acute distress and complaining bitterly of abdominal pain. The heart and lungs were normal. The relevant portion of the examination was limited to the abdomen, which presented boardlike rigidity, rebound tenderness, and generalized tenderness. There was a loss of liver dullness on percussion over the right upper quadrant and thorax. Peristalsis was not heard, and there was tenderness bilaterally on rectal examination.

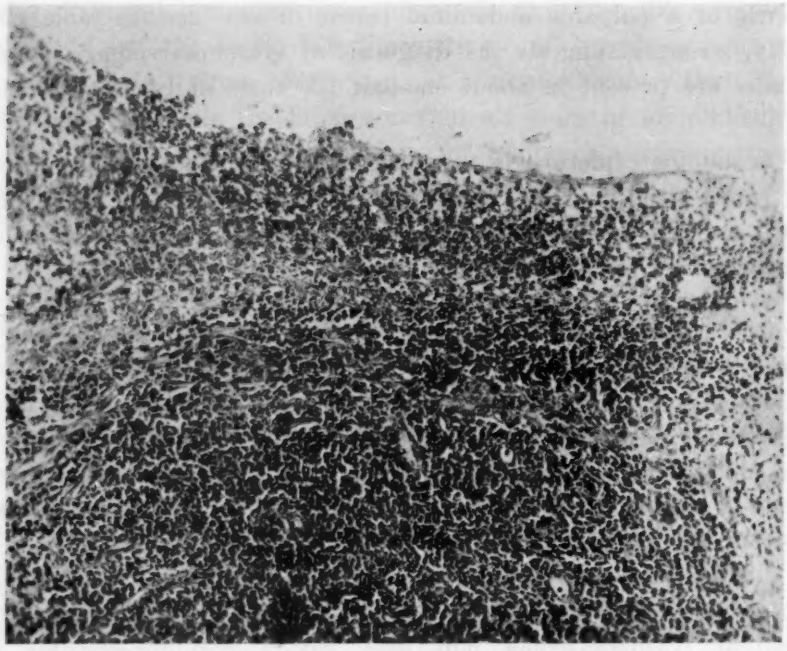

Fig. 1.—Section of floor of necrotic wall of duodenal ulcer removed at operation, showing infiltrating tumor underneath.

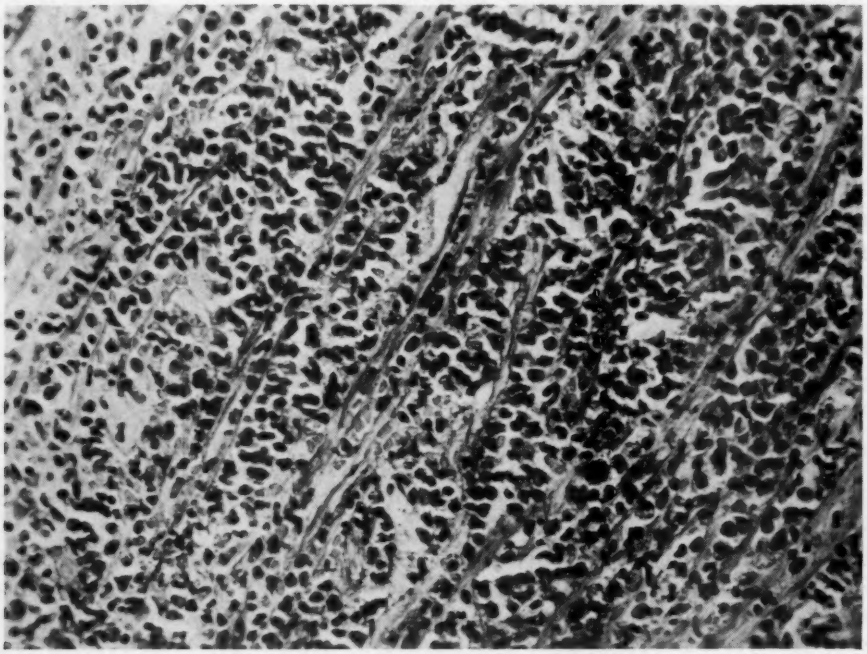

Fig. 2.—Diffuse infiltrating lymphosarcoma in duodenal wall.

Clinical impression was that this patient presented a typical picture of perforation of a viscus, more likely a peptic ulcer of stomach or duodenum. He was prepared and immediate operation performed under general anesthesia.

A high right rectus incision was made, and when the peritoneum was opened, gas escaped and gastric contents were seen. These were removed by suction and sponging, and after adequate retraction the area of perforation was visualized. In the first portion of the

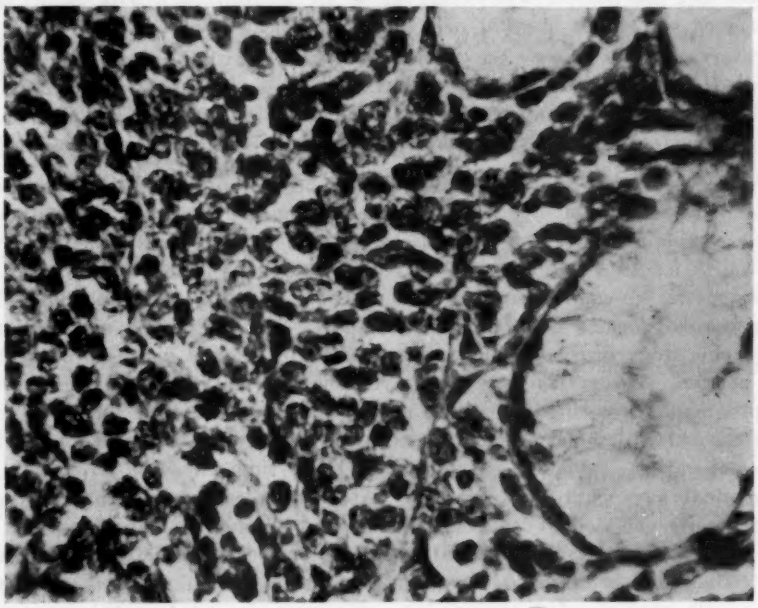

Fig. 3.—High magnification of lymphosarcoma in duodenal wall, showing numerous mitotic figures.

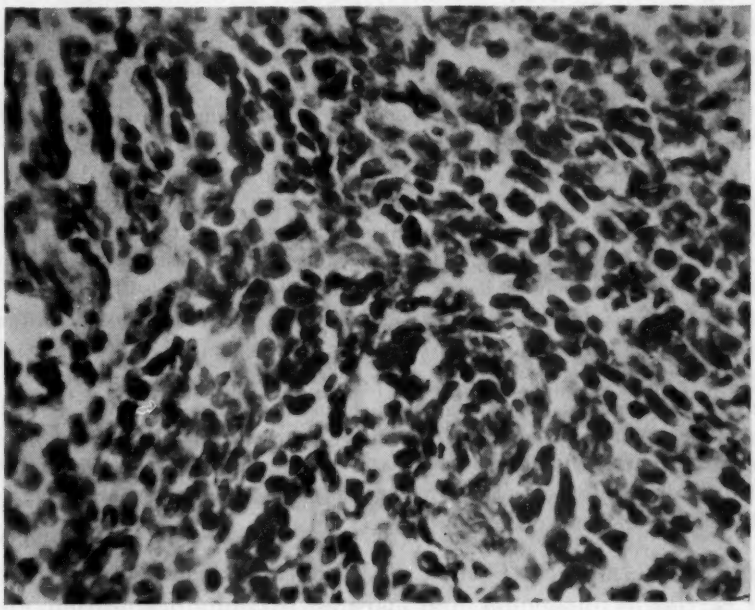

Fig. 4.—High magnification of section from nodule removed from abdominal wall seven months after original operation, showing diffuse lymphosarcoma.

duodenum an indurated area approximately 3 cm. in diameter was found, in the center of which there was a perforation. The area was isolated by packs and excision of the ulcer performed, removing a diamond-shaped portion of duodenal wall. The edges were then approximated by transverse closure, using three layers of interrupted silk sutures. The abdomen was closed in the routine manner without drainage.

Postoperative course was uneventful. Temperature did not exceed 102° F. and by the third hospital day the patient was taking fluids by mouth and a soft diet. He was discharged home on the eighth hospital day with a well-healed wound and free of symptoms.

Laboratory findings during the hospital stay were within normal limits. Pathologic report revealed fibrosis incorporating deep-staining masses of cells which were chiefly inflammatory in nature, consisting of fibroblasts, plasma cells, red cells, and an occasional eosinophile; no evidence of malignant change in margins of this ulcer. Diagnosis was that of duodenal ulcer with thickening and inflammatory hyperplasia of borders.

Course.—For several months after dismissal from the hospital, the patient felt well and had few complaints. Weight was maintained and general health was apparently good. About the fourth month after operation he began noticeably to lose weight, and complained of vague epigastric discomfort, which soon became a painful cramp, relieved by food. Gastric analysis five months after admission revealed free acid of 56 and total acid of 59. Roentgenographic study revealed evidence of a small filling defect and deformity of duodenum in the first portion. The patient was given symptomatic treatment. During the next month, downward progression was noted, with weight loss, poor appetite, development of progressively intense icterus, and liver enlargement. At six months, there was noted a mass in the field of previous operation, extending down about three fingerbreadths from costal margin. Bilateral inguinal adenopathy was present. At seven months, a nodule was seen in the skin of the anterior abdominal wall, at the site of a retention suture used in closure at operation. This was removed under local anesthesia and submitted for pathologic diagnosis. There was found very pronounced active lymphoid structure not typical of a lymph node. Most of the cells were rounded or oval but some were elongated in the manner of fibrous tissue. There were numerous mitoses noted and the picture as a whole was one of monotony found in lymphosarcoma. Upon re-examination of the original section removed from the duodenum seven months previously, essentially the same structure was seen in this section.

At this time it was obvious that the patient presented the picture of generalized lymphosarcomatosis, with intraabdominal spread, and involvement of inguinal nodes and abdominal wall. Deep roentgen therapy was given over a period of nine weeks, with a total of 3,100 r being received in three areas, the greater portion over the upper anterior abdomen. During this time the patient gained twenty-two pounds, felt better generally, and the icterus lessened.

Death occurred July 11, 1940, ten months after the original hospital admission, from bronchopneumonia superimposed upon general sarcomatosis. Autopsy revealed extensive involvement of all structures adjacent to the duodenum, biliary obstruction, and spread downward in the abdomen to periaortic nodes and bladder.

Microscopic sections were identical with that seen in nodule removed from the abdominal wall, and revealed the markedly invasive quality of the growth. Roentgen therapy had brought about partial remission in some areas, with fewer mitotic figures seen.

Detailed examination of the duodenum, pylorus, and stomach showed no extension into the stomach proper, but an extension of the tumor proximally to the pylorus and posteriorly into the pancreas and structures of the hepatic ligament. The entire first portion of the duodenum had its wall almost completely replaced by malignancy with thickening and fixation, involving the biliary and pancreatic ducts.

Summary.—A case is presented of a 40-year-old man with lymphosarcoma of the first portion of duodenum, first manifest by acute perforation, and steadily progressing over a ten-month course with generalized spread and only fair re-

sponse to roentgen therapy. Diagnosis was first established seven months after the onset of symptoms by biopsy of nodule in the abdominal wall at the site of the previous operative wound.

DISCUSSION

From the case report just given, it is obvious that no preoperative diagnosis was possible, since the disease was first brought to the attention of the attending surgeon because of an acute abdominal catastrophe. Furthermore, the patient had had no premonitory symptoms, such as one might expect with ulcer.

At operation, since the lesion presented the identical picture of the many times more common duodenal ulcer, nothing unusual was suspected. It is a well-established surgical dictum that perforating lesions of the stomach should always be subjected to biopsy. Here, however, perforation occurred in a region seldom involved by malignancy. Nevertheless, as had been the practice of the surgeon in similar cases, excision of the ulcer was performed.

Unfortunately, a mistaken pathologic diagnosis of the tissue removed led to a diagnosis of benign ulcer and a policy of temporization. Not until four months had passed did the symptomatology of the true lesion begin to manifest itself. Roentgen examination at this time revealed the duodenal deformity, and the weight loss, digestive upset, and lymphadenopathy pointed clearly toward malignancy. By this time the lesion was inoperable. Response to radiation therapy was not typical of the remission seen in most radiosensitive lymphosarcomas.

From this case, and from a review of literature dealing with this subject, certain generalizations can be drawn regarding this class of tumors, and the possibility of making the correct diagnosis and instituting definitive treatment:

The presence of a tumor of the gastrointestinal tract in a relatively young individual, particularly with associated weight loss, anorexia, pain, bleeding, or lymphadenopathy, should suggest lymphosarcoma as one possibility.

Wherever feasible, biopsy should be taken of perforating lesions, in the event that an infrequent case of lymphosarcoma might be discovered and indicate decidedly different treatment, both surgical and radiologic.[18]

All palpable abdominal tumors should be explored, and a diagnosis should be established by an excisional biopsy and examination by a skilled pathologist.

Lymphosarcoma of the gastrointestinal tract carries a quite different prognosis from other tumors and demands different treatment. The marked radiosensitivity may bring about a remarkable regression of far-advanced lesions.

The ileum, stomach, and cecum are the most frequently involved sites, although the disease may occur at any level of the gastrointestinal tract. It occurs more frequently in the small than the large intestine.

Whereas local spread and metastasis occur rather late in carcinoma, the reverse is the rule with lymphosarcoma, in which local spread is rapid, and metastases to distant organs are not unusual.

Although most cases of this disease will have some premonitory symptoms, the occasional case that first presents by an acute abdominal condition should make one mindful of the possibility of its occurrence and occasion an adequate biopsy. In reducing small intestine intussusception, one should palpate carefully for possible submucosal tumors.

SUMMARY

A brief résumé of the problem of lymphosarcoma of the gastrointestinal tract has been presented, with consideration of the pathologic features, incidence, differential diagnosis, and roentgenographic findings. A case of lymphosarcoma of the duodenum, masquerading as perforated peptic ulcer, is presented.

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AMNIOTIC HERNIA

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THE congenital disorder referred to here as amniotic hernia goes by a large variety of names. It may be well to refer to Fig. 1 to see exactly what is meant. Cullen[1] in his monumental work on the umbilicus called it an amniotic hernia or an amniotic umbilicus. Ladd and Gross[2] referred to it as an omphalocele. Other terms used are congenital umbilical hernia, umbilical eventration, funicular hernia of the umbilicus, exomphalos, and hernia into the umbilicus. The term amniotic hernia most clearly defines it, I believe.

Under any name it is to be differentiated from the common variety of umbilical hernia of infants and adults as well. The incidence of occurrence is estimated at 1 in about 6,000 births, while the common umbilical hernia is perhaps 1 in 50 at birth. The pertinent difference is that in the usual hernia the bowel is covered with peritoneum and skin and may be treated without operation or may be operated upon at any time, unless, of course, there is strangulation. In this disorder the abdominal contents are visible through only a thin, transparent, and avascular membrane. It is an emergency condition demanding prompt operative repair because otherwise it is inevitable that there will be rupture with evisceration or else a drying of the membrane with cracking and development of peritonitis. Indeed, in one of the cases which I shall describe the rupture had occurred before birth.

There are various degrees of severity. The least severe is that where a loop of bowel protrudes into the cord through a relatively small (1 to 2 cm.) hiatus in the fascia. This condition is quite properly called a herniation into the cord. In this paper I propose to deal largely with the most severe form where there has been a failure of development of the abdominal wall, resulting in a hiatus some 10 cm. in diameter and with a great part of the abdominal organs in this protruding amniotic sac. It is not uncommon for other congenital defects to be present.

Inasmuch as this is a developmental disorder, some reference to the embryology involved is in order. The amnion is first seen in the human embryo of less than 1 mm. in length as a separate cavity on the dorsum of the embryo. As development proceeds the amnion encircles the embryo, attaching to the body stalk. As the body stalk becomes the umbilical cord, the amnion forms the outer layer of the cord and attaches to the skin around the umbilicus. In the 10 mm. embryo the small bowel has begun to elongate and to be present in the cord. In the 18 mm. embryo the small bowel, cecum, and some colon are all in the exocoelomic cavity which is in the cord outside the embryo. The liver, however, is not normally in the cord at any time. In the 45 mm. embryo, which is at about 9 or 10 weeks, the bowel has normally receded into the abdomen and remains there.[2, 3] The presence of bowel in the cord at birth is, therefore, a

Read at the annual session of the Southern Surgeons' Club, May 20, 1947, Atlanta, Ga.

severe aberration. And the presence of liver, spleen, or stomach is not accountable because of the persistence of any developmental situation, but is the result of true herniation into the sac during the latter months of gestation.

The membrane which covers these herniations is variously described as amnion and peritoneum. Grossly it is a single layer.

I have had the occasion to treat several infants with the herniation into the cord of a loop or two of small bowel or small and large bowel. If the hiatus in the fascia is small, it is an exceedingly simple operation and the results are uniformly successful. The only question in this type is whether or not the smaller ones should be operated upon. If the skin edges will come together as the cord dries and if the bowel can be held in the abdomen during this ten-day period, there will be normal healing of the skin. A subcutaneous hernia may result. I recommend, however, that all of the patients be operated upon immediately if there is any doubt because the bowel cannot be held back with

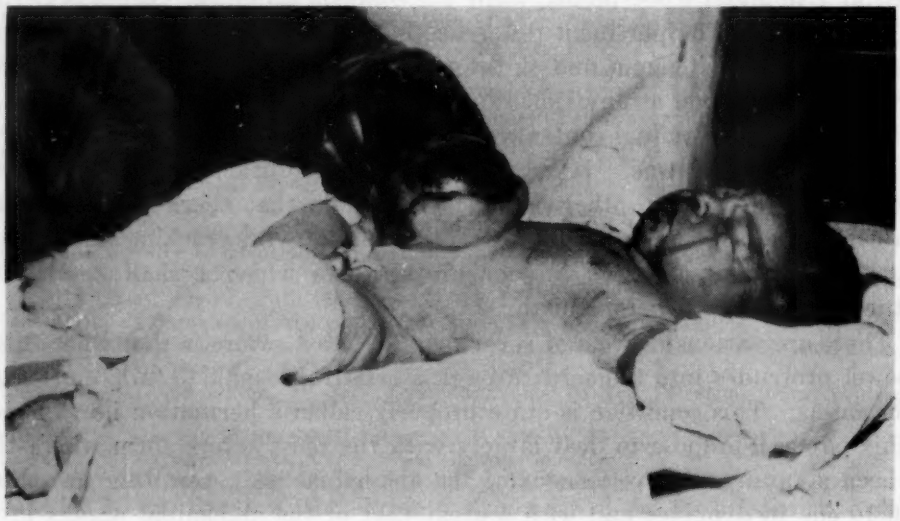


Fig. 1.—Amniotic hernia in an infant being prepared for operation within an hour after birth. There was no skin extending on the sac on the other side.

certainty in a crying infant. There may be a rupture of the sac by such crying or by the trauma of the external dressing. This is the type of hernia where bowel may be included in the cord tie and with disastrous results. Most obstetricians are alert to this danger. I had a case of this kind at our St. Vincent Infirmary in 1946. The infant was admitted five days after birth, moribund from intestinal obstruction since birth. The cord was dry and intact but a bit infected. When it was manipulated a little, feces escaped and deflation promptly occurred. This infant died in a few hours, however. Another infant was admitted twelve hours after birth with a proper tie of the cord and obvious herniation into the stump. When the dressings were first removed to examine him, this sac ruptured and bowel protruded. The bowel was not grossly contaminated and operation was accomplished within the hour. He left the hospital the next day to be returned to his mother for feeding and made an uneventful recovery.

Of the type shown in Fig. 1 and containing liver, I have had four cases in the past eight years—one at our St. Vincent Infirmary, two at the Arkansas State Children's Hospital, and one, strangely enough, in the Army at the Bushnell General Hospital. The illustrations, herewith, are all of the last case.

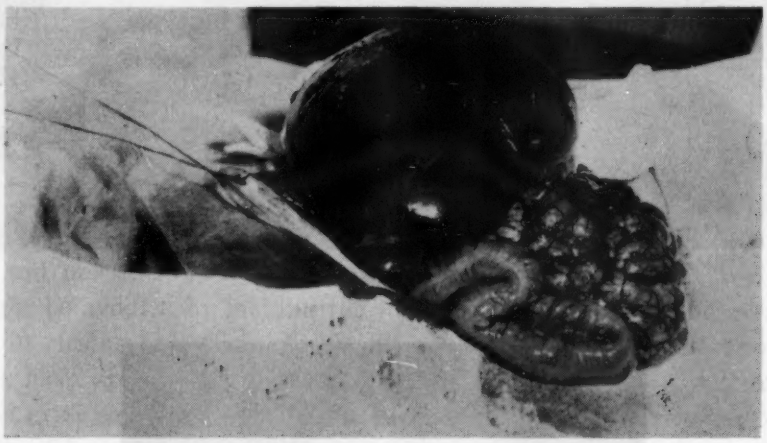
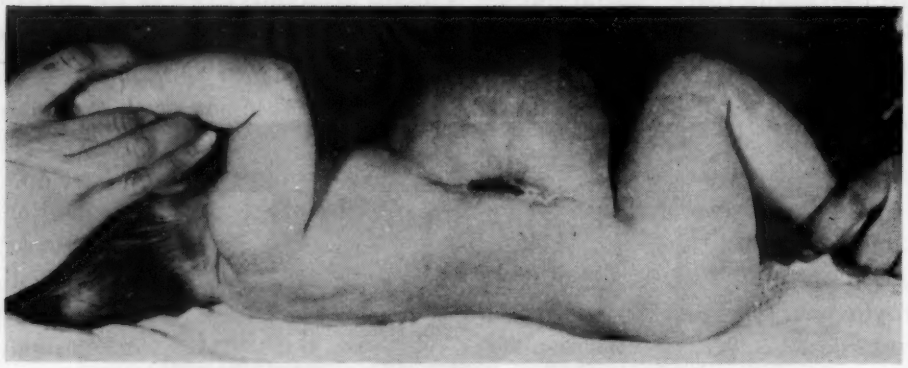


Fig. 2.—Complete evisceration during operation. This undesirable situation can hardly be prevented once the sac has been opened. The enormous size of the liver is apparent. There is no place for it within the abdomen.

Fig. 3.—Closure at end of operation. The relaxing incision was used only on one side and only in this one case. It helps very little in our experience and may complicate later procedures.

One of these infants was born with a rupture of the sac and an evisceration of liver, and all bowel. The presence of well-organized fibrin indicated that rupture occurred well before the day of delivery. He was in excellent condition and was operated upon immediately. Another infant was seen five days after birth. The membrane had become dry and opaque but had been kept fairly clean and had not cracked through. All of these patients made uneventful recoveries following operation and remained well for one or two years. It is interesting that none had any other congenital disorder which was ever recognized.



Figs. 4 and 5.—Results at approximately 3 weeks and 3 months. Although the general health is excellent, it is an entirely unsatisfactory end result.

There are several important technical points. Operation should be done as promptly as possible following delivery. Babies at birth are prepared for an ordeal and stand the procedure well. I have done them all under local anesthesia and very little of that. There is no such thing in my experience as opening one end and closing bit by bit without evisceration. All of the contents eventually escape during the procedure, as shown in Fig. 2. The umbilical vessels and urachus must be carefully tied but cause no special concern. Every millimeter of skin at the edge must be saved. It is the most difficult abdominal closure that I have ever encountered. Relaxing incisions on the sides are always described but help very little. I have used it only on one side in one case. At the area shown in Fig. 3, there was no recognizable muscle and poor fascia. In order to get any relaxation it is necessary to incise through skin and peritoneum and one then has the problem of evisceration through two incisions. This might be avoided by making the incision further back. The greatest difficulty is in closing the skin over the liver rather than over the bowel. Some operators have excised part of the liver. This is too radical. All the patients have died after such a resection. The liver is proportionately larger in infancy than later. These livers seem to be larger than in the normal infant. The wound must be closed from the upper end down and one has to be content with a covering of skin and subcutaneous fat only and a single layer of stitches in the skin. The liver must be covered over first and the bowel replaced last. The so-called "umbrella trick" is invaluable. This maneuver consists in placing a single layer of gauze over all the eviscerated organs and tucking the edges under the sides of the incision. The organs can then be better replaced and the skin covered over. The gauze is the umbrella. Getting the gauze out is the trick. It is very traumatizing to bowel but accomplishes the purpose.

In these four cases there were no immediate postoperative complications, although these infants are prone to have such complications of the chest or abdomen. However, the result as seen in Figs. 4 and 5 is most deforming and unsatisfactory. The contour of the baby's abdomen is somewhat like that of a woman at term but with the protuberance even greater and higher. It is difficult to apply any sort of an abdominal support which does not cause improper pressure.

The important part of any treatment is the end result. The end results in these cases which started so favorably are bad. Of the four patients, three have died in their second year. I do not have a follow-up on the fourth. One died of intestinal obstruction. This is not surprising with only skin covering all the bowel. The other two died of pneumonia. This too is significant when one considers that the liver has never had its normal position, the diaphragms are not properly developed, and there is no firm abdominal wall to support a cough.

These late fatal complications can be overcome only by some procedure which will construct an abdominal wall and perhaps by some form of mechanical support which will gradually force the liver back into the abdominal cavity.

Dr. Ladd has corresponded with me on this matter. He states that he knows of only one or two cases of this type in which the infant has survived any appreciable period of time. He and others suggest that on about the tenth postoperative day a series of operations be begun to bring the fascia together. Only a little can be done at one end at each sitting. When one recalls how far laterally the edge of the fascia is situated and how difficult it is to bring only skin together, it is difficult to visualize a successful accomplishment of this plan. However, I intend to try it at my next opportunity. Other ideas such as a free transplant of fascia or a dermal graft do not appeal to me but may have merit.

The problem of the construction of abdominal wall in these cases is a real challenge and I shall look forward keenly to the ideas that others may put forward.

ADDENDUM

Since this article was received for publication, Dr. Robert E. Gross, of Boston, Mass., has presented a new method for the operative treatment of these large hernias containing liver. He has utilized the method with complete success in three cases.

The sac and abdominal wall are thoroughly cleansed with soap and water and half-strength iodine. The skin is completely divided along the circumference of the sac leaving a tiny rim of skin fastened to the sac and taking great care not to enter into the abdominal cavity at any point. The skin is then mobilized over a large area in all directions sufficient to allow it to be brought up and cover the entire amnion and stump of the cord. The effect at the completion of this operation is similar to that following the operation depicted in this article. Adhesions, however, do not develop between the liver, bowel, and the skin covering because of the presence of the amnion, and a second operative procedure at the end of some six or nine months can much better be done with a layer closure.

This method obviously avoids many defects in other plans of treatment. While there are certain risks in regard to infection, to the formation of subcutaneous cysts, and to the possibility of sloughing of skin, the advantages greatly outweigh the disadvantages. The method would hardly be applicable in such a hernia which is ruptured or in one which has been neglected and is grossly infected.

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THE IMPORTANCE OF ACCURATE PATHOLOGIC CLASSIFICATION IN THE PROGNOSIS OF RENAL TUMORS

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INTRODUCTION

DURING the period of fourteen years from 1932 to 1946, 75 patients with renal tumors were admitted to the Cornell Urological Service of the New York Hospital and in 58 of these the diagnosis was confirmed by nephrectomy and pathologic examination; on pyelographic examination, the remaining 17 showed very suggestive pictures, but as most of them also exhibited evidence of advanced metastasis, palliative rather than radical treatment was indicated. A review of the 58 well-documented cases has been undertaken and the correlation of clinical and pathologic findings with the end results attempted.

Although a few tumors were discovered relatively early in the course of investigation for some other complaint and before hematuria was apparent, operation was omitted in none unless proved metastasis was present. There was one exception to this rule: a patient in whom a craniotomy revealed a probable single metastasis from a renal-celled carcinoma and craniotomy was followed by nephrectomy. The operation of choice was nephrectomy, which was performed in all but two instances through a flank incision; the exceptions were carried out transperitoneally. It is not the purpose of this article to detail the surgical signs, symptoms, or operative technique; we intend to confine ourselves solely to the correlative analysis just indicated.

The series has been grouped according to the pathologic diagnosis in each instance: it comprises 39 renal-celled, 2 tubular, 5 transitional-celled, and 3 epidermoid carcinomas; 4 embryonal tumors (two of them muscular), two non-malignant transitional-celled papillomas, and one Wilms' tumor. Classification of renal tumors into these categories appears to be significant and helpful in judging the prognosis—more so than when older and purely descriptive classification is used. (Hypernephroma, clear-celled carcinoma, granular-celled papillary carcinoma, etc.)

There is justification on histogenetic, pathologic, and clinical grounds for classifying renal tumors under two main heads: those of mesodermal origin and those obviously arising in entodermal conduction apparatus (calyces, pelves, ureters). As will be discussed later, it is found that tumors of the former category offer a much better prognosis than do those of the latter, which appear to be hopeless if they are metaplastic.

A brief classification might be couched as follows:

A. Tumors Derived From Mesodermal Renal Cap
   Simple adenoma
   Renal-celled carcinoma, including some tubular forms

B. Tumors Derived From Entodermal Outgrowth From Cloaca
   Transitional-celled papilloma
   Transitional-celled carcinoma, epidermoid carcinoma, and some tubular carcinomas (of collecting tubules)

C. Tumors Derived From Embryonal Tissue Such as Mesonephros
   Embryonal carcinoma (juvenile and adult forms), mixed embryonal tumors, including that of Wilms

D. Tumors Derived From Perirenal Capsule
   Fatty, connective tissue, muscular and nervous growths.

Our investigation at once brings out the fact that renal-celled carcinoma is by far the commonest tumor of our service; its nearest competitor is the transitional-celled carcinoma, which takes first place among neoplasms of the urinary bladder.

Renal-celled carcinoma was first known as "hypernephroma," so named by von Grawitz[1] in 1884, who believed it to be the product of displaced suprarenal primordium. Later, Ewing[2] distinguished a microscopically different, but grossly similar tumor as "clear-celled carcinoma," basing his nomenclature upon the prevalence of clear cells grouped into tubules and papillae. Without going into details as to the dispute concerning the origin of this growth (which followed Stoerk's[3] claim that it was derived from renal parenchyma) it may be said that authorities are beginning to call it "renal-celled carcinoma." Although there is a similarity to suprarenal cortex in its histology, it is readily distinguished from true cortical suprarenal tumors. Unlike them it causes no hormonal symptoms such as virilization or devirilization. It is therefore presumed that it originates from cells of the mesodermal portion of the renal parenchyma.

In discussing this subject Stoerk said in a footnote: "It is quite incomprehensible to me that the similarity between the cells of this tumor and those of the adrenal is constantly being stressed. . . . . I cannot observe the slightest similarity. That of the cellular architecture of many Grawitz tumors to that of the outer zones of the adrenal is, of course, admitted without comment."

His conclusions were: "I have endeavored to make it evident that there is no convincing similarity between tumors derived from suprarenal or renal tissue; secondly, that the most variable forms of Grawitz tumor prove to be histological variants of the same archtype and, thirdly, that Grawitz tumors of the kidney are of nephrogenic origin. The last conclusion might be formulated to the effect that almost all epithelial tumors of the kidney might in the end produce the picture of the Grawitz tumor."

Renal-celled carcinomas are characterized microscopically by the presence of large, vacuolated or clear cells arranged in cords, tubules, or more rarely, papillary formation. The cells may occasionally possess considerable granular cytoplasm and when this is conspicuous they resemble tubular carcinoma or the growth which Ewing called "granular-celled papillary carcinoma." The similarities may be confined to occasional fields only, but the inference that all

of these formerly separate groups may be essentially one large family, as Stoerk claimed it to be, is clear. Two of our specimens exhibited vacuolization of cells, or even of areas in carcinomas that were otherwise predominantly tubular structures composed of granular elements.

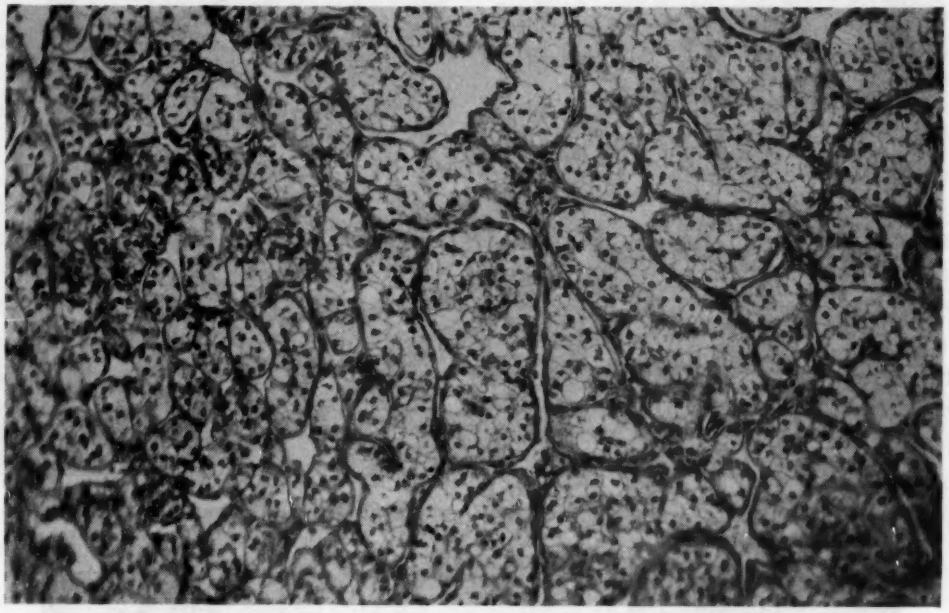

Fig. 1.—Microscopic field from a renal-celled carcinoma in a patient with a history of five-year survival after operation. Note its appearance and compare with Fig. 2. (All photomicrographs taken at ×150, by Department of Medical Photography, Cornell University Medical College.)

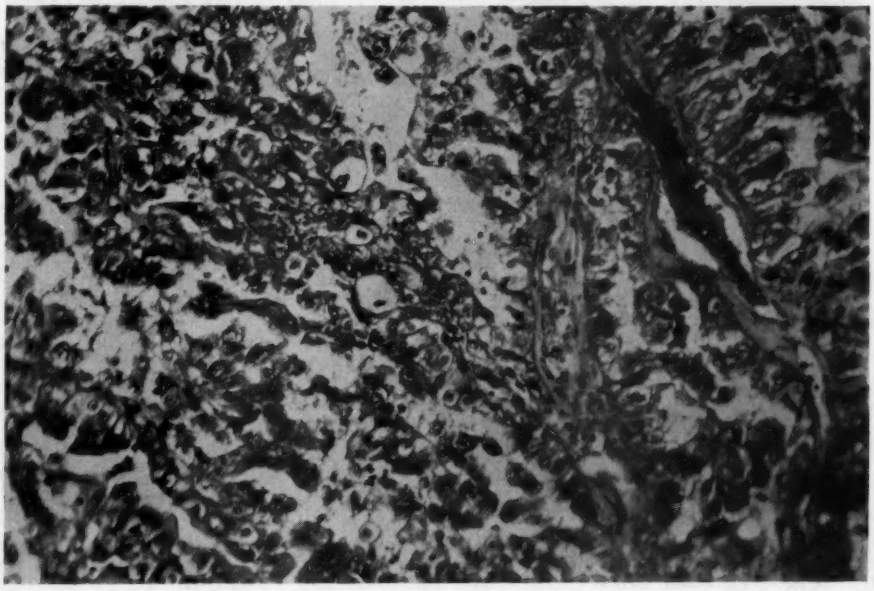

Fig. 2.—Field from a highly malignant and rapidly fatal renal-celled carcinoma. Note tubules, papillae, and generally disorderly architecture.

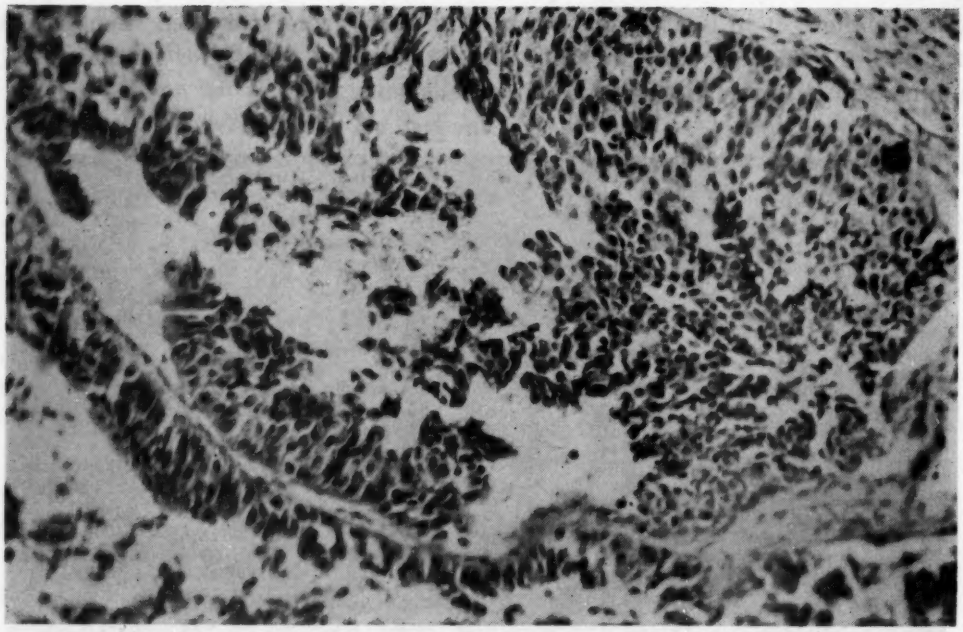

Fig. 3—Nonmalignant papilloma of renal calyx; note the excellent differentiation.

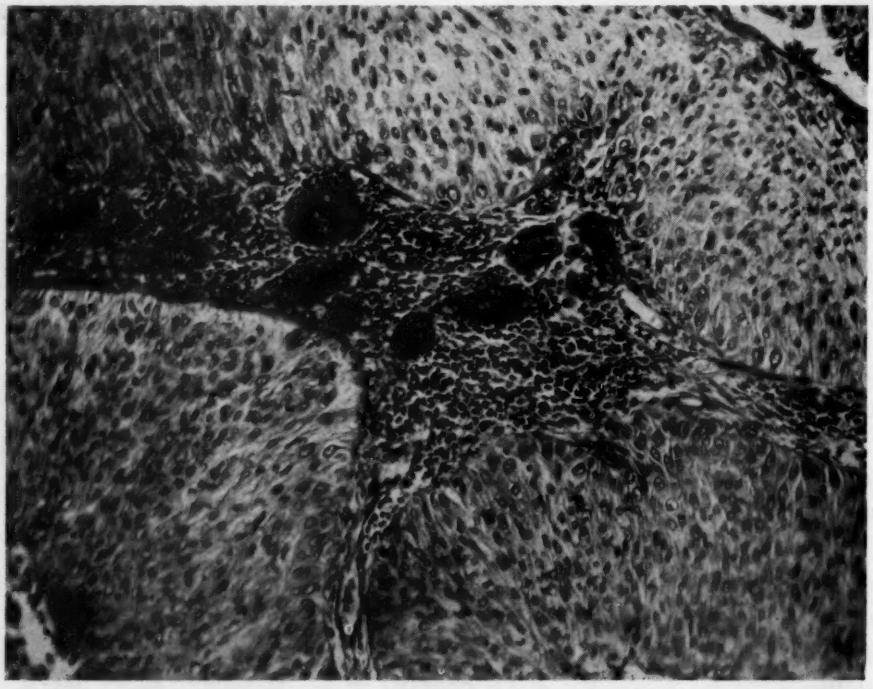

Fig. 4.—The malignant variety of the preceding type. Compare its lack of differentiation, its piling-up of cells, and numerous mitotic figures. This transitional-celled carcinoma was also situated in a large renal calyx.

Our transitional-celled tumors were either nonmalignant papillomas or carcinomas arising from the transitional epithelium of the urinary tract derived from entodermal hind-gut. The epidermoid carcinoma, as its name implies, is composed of epidermal epithelium derived from the transitional cells through a process of metaplasia that is exceedingly common in this tract and which does not necessarily lead to the production of malignant growths. (See Foot.[4])

CLINICAL FINDINGS

In evaluating our census of renal growths it will be seen that the renal-celled type outnumbers all others by a ratio of two to one; it has also offered a better life expectancy than have the other types. In order to test the survival rate of all groups of patients operated upon prior to 1943, known survival was listed after communicating with the patients or their families on the fifth anniversary after operation, either through personal interview or letters of inquiry. Deaths were listed after information was obtained from the family, or through examination of burial permits from the Mortuary Division of the New York Department of Health. All other cases were set down as "unproved," including those patients known to be alive shortly before the anniversary, as well as those lost to "follow-up" during the disruptions attributable to the war. Although much more accurate data might be obtained through the review of a longer series of cases, we believe that the trend established in ours is of considerable significance (Table I).

TABLE I

	TOTAL STUDIED	TOTAL OPERATED UPON PRIOR TO 1943	TOTAL PROVED 5 YR. SURVIVALS	TOTAL PROVED DEAD	TOTAL UNPROVED 5 YR. SURVIVALS	PER CENT OF 5 YR. PROVED SURVIVALS TO PROVED DEAD
Mixed embryonal	3	3	1	2	0	33
Embryonal carcinoma	4	4	0	2	2	0
Epidermoid carcinoma	3	3	0	3	0	0
Transitional carcinoma	4	4	0	3	1	0
Transitional papilloma	2	2	2	0	0	100
Tubular carcinoma	2	2	1	0	1	100
Renal-cell carcinoma	39	24	9	11	4	45

Reviewing these findings, pertinent facts may be adduced to assist in interpretation. The embryonal group showed but one five-year survivor, whose tumor was a leiomyosarcoma of pure composition, discovered incidentally during nephrectomy for tuberculous kidney. With that exception there were no known five-year survivals in that group, or among the epidermoid or transitional carcinomas of the kidney. The average expectancy here averages slightly over one year. By contrast, transitional-celled papilloma presents an excellent prog-

nosis; although this is based upon only two examples, it is believed that it parallels that of similar tumors in the urinary bladder. Were these to be grouped with renal carcinoma (as they are in some classifications) the expectancy for the entire group might be improved. This would, however, be based upon a fallacy. Transitional papillomas of the bladder usually have been found to respond to treatment, while the carcinomas of that type have a poor prognosis despite operation.

The renal-celled group, on the contrary, offer a fair expectancy of a five-year survival (45 per cent). On the basis of prognosis tubular carcinomas, probably closely related to these, appear to be equally favorable. Again the number comprised in our series is too small to be at all decisive. The figure of 45 per cent five-year survivals among the renal-celled tumors is probably on the conservative side, as one of these listed as "known dead" had a cerebral metastasis removed prior to nephrectomy and died four years after the latter from a local recurrence of the cerebral metastasis. There were also two patients who died of cardiovascular disease which was present at the time of operation and in each of these no evidence of recurrent tumor was forthcoming. Two of the "unproved" patients were known to be living shortly before their fifth anniversary and may still be alive, although we cannot prove it. Further accumulation of data on the entire series, after more time has elapsed, might raise the survival rate to 50 per cent. That the "cures" are not all permanent is demonstrated by one patient who died seven years after operation from pulmonary metastasis. No inference is drawn as to whether or not operation influenced the prognosis favorably in any of these cases, as we have no comparable group available in which the tumor was permitted to run its course without operative treatment. However, our belief that radical surgical intervention should be offered all patients is substantiated by the literature.[5] From the clinical standpoint the classification employed proves to have an important bearing upon the prognosis; from the standpoint of pathology it was found that certain features of the renal-celled group might be relied upon to indicate a prognosis within the category.

PATHOLOGIC STUDY

The entire series of tumors was reviewed microscopically and the diagnoses confirmed or corrected; it was found that cases prior to 1940 had been classified according to Ewing's ideas as either hypernephroma or clear-celled carcinoma; later the term "renal-celled carcinoma" was adopted. All this group was consolidated under the renal-celled category and some examples which had mistakenly been assigned to other diagnostic groups were replaced where they belonged.

Next, all examples of renal-celled carcinoma were assembled in a table recording the name of the patient, the type and date of operation, the presence or absence of metastases (as proved by x-ray examination or necropsy), and the date and given cause of death. In columns parallel to these were recorded various histologic features of the tumors: the size of the type cell, the nature

of its cytoplasm (clear or granular), the size and regularity of outline of the nuclei, the architecture of the growth (cords, tubules, papillae, etc.), the character of the stroma and septa and, finally, the presence or absence of inflammation and hemorrhage. After filling out this chart for the twenty-four tumors examined (from patients with documented histories) it was found that little of a definite nature could be adduced from the minutiae of the statistics.

It was, however, ascertained that a prognosis might be forecast with considerable accuracy, by examining the sections from the standpoint of regularity of architecture, absence of tubules and papillary growth, and the stoutness of the connective tissue septa. Tumors showing very variable cells or nuclei (anisocytosis and metaplasia) and readily discoverable mitotic figures were invariably found to have resulted fatally within a short time. In order to test the validity of these points, a series of sections from twelve cases was selected by one of us (G.A.H.) and submitted to the other for evaluation, with the understanding that they would represent an equal number of five-year survivals and proved deaths. Ten of the twelve were accurately assigned to the two categories, "good" and "bad"; one of the mistakes represented sections from a patient who had lived nine years, only to die of metastasis from a tumor that was unequivocally malignant in appearance. This naturally threw the remaining case into the wrong tray, as six had already been assigned to the "bad" category. Working from the opposite angle, the clinician was able to predict with astonishing accuracy, the probable structure, degree of differentiation, and microscopic appearance of the cells that would probably be found in sections from a given tumor. This further reinforces the idea that there is a definite correlation between the histologic picture and the clinical prognosis in the case of renal-celled carcinoma of the kidney.

In order to assist the reader in making a microscopic evaluation as to the prognosis in renal-celled carcinoma, it might be well to list favorable and unfavorable features. The relatively nonmalignant tumor shows: solid cords of large, clear cells with nuclei that are usually small and regular in size and shape; the growth is generally traversed by heavy septa of connective tissue; there is little microscopic evidence of hemorrhage and inflammation and the tumor is well delimited from the surrounding tissue, which it fails to infiltrate. The picture of tumors with an unfavorable prognosis reveals: cells of variable size often arranged in tubular or papillary formation; the nuclei are anisometric and mitotic divisions are readily noted, rather than being very difficult to find, as they are in the less malignant varieties. The septa are not stout, but poorly formed and usually infiltrated by lymphocytes or even polymorphonuclear leucocytes. Hemorrhage and necrosis are often noted. In short, well-differentiated tumors offer the best prognosis, while those with metaplasia and rapid growth (many mitoses) are to be feared. As a corollary of this, these tumors may be graded on the basis of differentiation, presence or absence of mitoses, and the nature of the stroma; Broders' method is, therefore, applicable in this case although it might work less satisfactorily in the case of other types of renal tumor.

CONCLUSIONS

1. In a series of 66 renal tumors, the renal-celled type of carcinoma (hypernephroma, clear-celled carcinoma) outnumbers the other forms 2:1.

2. Practically all other types of malignant renal tumor have at best a life expectancy of less than one year.

3. In the case of renal-celled carcinoma a prognosis may be based upon the microscopic appearance of the tumor with a reasonable degree of accuracy. The well-differentiated examples have a good chance of living five years or more.

4. A classification fundamentally based upon the embryologic origin of the tumor (entoderm or mesoderm) is the most reliable regarding correlation between pathologic findings and clinical outcome.

5. Entodermal tumors and those developing in more or less mixed mesonephric rests bear an almost hopeless prognosis; with mesodermal tumors the outlook appears to be better, particularly in the case of well-differentiated examples.

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OBSERVATIONS OF SURGICAL TRAINING

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HALSTED introduced a method of training surgeons shortly before the turn of the century which, collecting few advocates at its inception, gained momentum in the 1920's and finally achieved widespread recognition in the middle 1930's. Historically, this so-called resident system can be traced to a somewhat similar system in vogue in Germany and Austria at a time when German and Austrian surgery was at its height and set a high standard for the surgery of the period 1880 to 1914. Whether or not Halsted copied this continental system is a controversial subject, but certainly one can safely conclude that his annual sojourns to European clinics were a source of stimulation to him and influenced the teacher Halsted materially. It is also believed that his original aim was to produce teachers of surgery, primarily, and that these teachers in their dissemination throughout the country would spread the gospel for development of good surgery and surgical research. Dr. Heuer is of course one of these stalwarts who introduced the system in two of our large cities. His everlasting belief in the method has resulted in the training of a large number of surgeons. In time, students of Halsted satellites began to spread and to function as teachers.

In the 1930's, however, the need for a great number of teachers diminished simply because each new "mother university clinic" was feeding teachers into the communities and a saturation point was beginning to be reached. In 1935 to 1937, with the great impetus of the American Surgical Association and other surgical societies, the American Board of Surgery was founded, setting up the formal training requirements of the surgeon and empowered to check on his ability by critical examination which if successfully passed certifies him as a qualified surgeon. This first real attempt to show the lay community surgeons who could be trusted in the matter of diagnosis, pre- and postoperative care, and safe operating skill is already a significant landmark in the progress of surgery. The first generation of Halsted disciples must have all experienced a sense of satisfaction with this tribute to their method of teaching surgery which had now received acclaim by the surgical professional public. Now that the saturation point of surgical teachers is at hand, the natural flow of this talent will be into the community hospitals and clinics where teaching is not of major importance compared to the routine care of patients. This new migration of surgeons must necessarily raise the standards of surgery more generally throughout the country.

The following observations are collected from firsthand experience of working side by side with surgeons representing almost all types of teaching institutions. Statistically, the observations are not significant; I know of no method by which this can be statistically studied. Lacking that, however, general observations by an unbiased observer in the United States Army

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Surgical Service and the Veterans' Administration Hospitals may be of value. It was my privilege to function as surgical chief in three general hospitals. The 9th General Hospital experience was not of great value in this respect because the capabilities of the surgeons during my chiefship were known and the men were similar in their training and ability to function. The tenure as Chief of Surgery at Lovell General and Walter Reed General Hospitals was at the height of these hospitals' activities, which included all conditions of surgery even those of women and children and in great numbers. Here, naturally, were sent general surgeons, orthopedists, urologists, neurosurgeons, thoracic surgeons, and gynecologists. To obtain the best surgical care with the surgeons sent to these hospitals, the foremost problem of the chief was to decide the surgical dependability of his staff and allot chores accordingly and regardless of rank.

At no time did the office of the Surgeon General interfere with this progress. On the contrary, his surgical and surgical specialty consultants were of great value in accomplishing these good results. The consultants, in my opinion, did a splendid job in allocating surgeons finally, oftentimes amid great confusion. The nature of their work, however, allowed them only a superficial estimation of an individual surgeon's true worth, compared to that of a chief who was working with these men daily and nightly. Some of the consultants were uncanny in their correct selection with so little actual knowledge of the man. Also, evidence is now being accumulated from work done in a large nondomiciliary Veterans Administration hospital in which surgeons from many different schools and clinics are functioning. The postwar confusion and overcrowding in our civilian hospitals have made it possible to work with the cream of the crop of prewar medical graduates, who have had various periods of time in training in the best of our university clinics and other clinics. Carefully selected, none of them is an exception to the usual product of his respective school or clinic. All are in training at this hospital with the same competitive atmosphere which exists in our university clinics.

It should be pointed out that allowance must be made for the personalities of the men, and it is realized that a few very good men have been observed who did not have the advantages of proper training and, conversely, a few very poor men came from institutions of the best opportunity for good training. There are not many of these. The virtues or failures in these few men were attributable to the men rather than the surgical school.

UNIVERSITY CLINICS

By and large, the best surgeons come from the University clinics. But the degree of surgical efficiency in men from the different clinics varies greatly, although this group represents those schools claiming the method of the Halsted resident system. If surgeons sent out from these schools are a reflection of the worth of the teaching method used, then there is great variation of local factors existing in the different schools. The study of these different surgeons is extremely interesting and no one knows what the perfect graduate resident surgeon should be like. We all expect him to be, first, a

fundamentally sound clinical surgeon, capable of handling all surgical problems with logic and skill; second, that he might be desirous of teaching good surgery; third, that he might be capable of either doing surgical research work or stimulating others to do it; and, last, from the nature of his residency that he be able to organize teamwork with other surgeons, nurses, and orderlies which will result in better care of surgical patients. Because surgery is a dangerous form of therapy, it is mandatory that he meet the first category or he fails.

This mirror reflects fairly accurately the desires and capabilities of the surgical departments. These surgical schools demonstrate characteristics which alter the type of surgeon finishing his residency. They may be conveniently classified as follows:

1. The resident is a first-class clinical surgeon.
2. The resident's qualification is that of a surgical researcher.
3. The resident is a prolific writer, but not a top-grade clinical surgeon or researcher.
4. The resident is a good organizer of surgical work.
5. The resident represents a type exuding medical political influence.
6. The resident is a good clinician and excellent teacher.

Undoubtedly, many combinations exist in some instances, but rarely are all six characteristics present.

1. *First-Class Clinical Surgeon.*—Students from the group of first-class clinical surgeons are surgically dependable, can be turned loose with a lot of patients under their care, and very good results follow. Some from this school are unable to organize the work of others successfully and their scope for handling large sections of the hospital is distinctly handicapped. They are the people who give good personal care. They are resourceful, rarely get into serious difficulty, and know the practical points of obtaining good results. They are usually equipped with different surgical methods and can use the different methods to advantage.

2. *Surgical Researcher.*—The pupils from the surgical research type of school are stimulating and interesting. They are likely to be of the prima donna type and are not as dependable as those of the first group. Unquestionably they can discuss the theoretical aspects of selected subjects with great thoroughness and persuasiveness, and at the same time minimize the importance of and demonstrate little knowledge of the routine surgical problem. Among them are a few who believe that they have received a halo from their teacher which will permit discussions and opinions that oftentimes approach the ridiculous. Close scrutiny of their past experience reveals that they not only did not handle such a case, but never saw one. There are a few from this school who are surgically meek; large surgical services can find little use for these. One or two students have unhesitatingly requested to work on a laboratory problem instead of clinical work, if facilities were available. Although it is not an observation collected from working side by side with this group, one realizes that in their number perhaps may lurk the small group of

surgical savants, discoverers, and real contributors of the surgical future. These students are usually not good teachers.

3. *Prolific Writer.*—The students of the type who are prolific writers include some good average surgeons. They tend not to care so much for the personal side of the work but rather to keep their eye cocked continuously for the unusual, the rare—something about which they can write a paper. In this search for literary achievement, they experience episodes in surgery that ultimately better their technique and, often with chagrin, their surgical judgment. They are all inveterate readers. A few will become impressed from reading the literature and become diverted to the detriment of their surgical judgment. These few are in the group who will deny in 1950 that they vigorously supported an incorrect procedure in 1940. Most of them are good speakers, they are good at planning meetings, and are good teachers, if the one in charge of the student will insist that he teach correct facts.

4. *Organizer of Surgical Work.*—The good organizer type is usually well founded in fundamental principles. This surgical department will often collect good teaching clinicians and excellent researchers. The pupil demonstrates a mixture of the two influences. The surgeon is likely to have a too limited experience because of the organizer's flair for dividing his surgical department into specialties and subspecialties, and the student has more useful knowledge in some case groups than he does in others. He is distinctly mindful of statistics, often altering judgment which could be moulded by knowledge and common sense to such an extent that a poor procedure and unsound choice of action is pursued. He fails to allow the exigencies of the individual case to aid him in the choice. Conversely, and sometimes with what appears to be bitter defensive stubbornness, he selects a plan because the statistics will reflect that plan's efficiency in a large group of cases, yet in a particular case a keen clinical observer could solve the problem because he applied his course to the individual patient's needs rather than to what ought to happen by statistical prognostication. On this case a well-balanced, less highly trained individual will often offer the better solution because he merely uses his knowledge, common sense, and desire to get the patient well. This surgeon thinks in terms of large groups rather than an individual patient. He can carry out orders well and is dependable. All correspondence and paper work are of the first order. Records are meticulously compounded and filed. Imagination and originality are not among his assets, and he therefore seldom offers the bold courage and resourcefulness necessary for the development of distinctly new ideas. He is master of any procedure which he learned in his training period, conversing about it in almost textbook diction. For some undetermined reason, he is more often in the class of "hard luck" surgeons than his confreres.

5. *Medical Political Influence.*—Fortunately, only a small group of men with political influence is observed. They are not good, dependable surgeons. Their main fault lies in their attempts to woo their supervisor by nonprofessional extracurricular activities. They are masters at work delegation, but always in a manner in which the creditable work accomplished is the concern

of the delegator rather than the delegatee. They establish contacts easily, but drop them just as promptly if considered unworthy. If given the responsibility of a ward or section, they are continuously in trouble with important clinical matters, but have convinced their associates and nurses that the poor results are inevitable, occurring in all other sections handling similar conditions. Their occasional pursuit of the literature is in the form of a search to find someone who at some time or place has put down on paper the unsuccessful plan used in this incident. The finding of this literary antique is the cause of real joy and full rationalization of a mistake. Consequently, this man neither improves nor can be expected to improve. He contacts all surgeons with "big names," quotes them voluminously but with great inaccuracy. He is undoubtedly the poorest of the group of university trained men. He is also dangerous. This surgeon, when exposed in his unhappy surgical career, seeks transfer and escape from scrutinization, but always convincingly points out what the original place loses in his ultimate departure. In this gesture he usually attracts a small group of confederates who are often either totally ignorant or are of the same type. His only forte is in his ability to delegate responsibility to others, and ride to what he considers fame by their efforts.

6. *Good Clinician and Good Teacher.*—The pupils of the type of good clinicians and good teachers are the best in the group. They have been trained by a broad-minded man who allows them to increase their surgical responsibility as time advances. Hard work and long hours accompany their triumphant advancement. Fundamentals are well rooted, and the pupil is not allowed to advance without them. His appointment for senior resident is made upon strict, ruthless honesty. If the school contains good clinicians as well as teachers, then the ultimate in surgical training is reached. He is capable, dependable, strictly adheres to an almost idealistic standard and will spend hour upon hour accomplishing these ideals. Nothing is too much trouble for him, if that is necessary to have things right. He is meticulous, uses splendid judgment, is a good technician, appraises the need of pre- and postoperative treatment logically, keeps excellent records, and is a great stimulation to those under him. He definitely exhibits surgical poise, has lost the confusion and erratic bewilderment of the novice, is a great teamworker, and is often a great teacher.

He is an inveterate searcher for surgical knowledge and approaches all cases, even the simplest, with a desire and attitude that he not only can but will learn something from them. He is the type of surgeon who lives for surgery even without great financial gain. He has fun in his work, and it is fun to work with him. Mistakes are honestly bared, studied, and ways and means for nonrepetition of them are planned. A great many in the group are interested in clinical research, are always considering certain newer phases as an *Arbeit,* can collect data with critical analysis, and are honest enough intellectually to abandon the project unless it proves to be a worthy one. Their observations are the best. Few are extremely interested in animal experimentation, more or less as a hobby or a correlated aid to their clinical progress. They do not attempt new difficult procedures without learning principles in the laboratory first if possible. As a group they are good

handlers of men and know how to get the job done. They are always searching for that little added maneuver to help the situation. Their only fault lies in their respect for idealism. When the facilities are not really adequate, their artistic pride is sometimes injured to the point where they are unable to function. In this they appear to lack resourcefulness. Actually, they are resourceful but their large previous experience with good facilities has tended to spoil them, and it is the compromise of their ideals that frightens them. Fortunately, there was not much of this, because the Army surgical facilities in spite of great hazards were most often adequate and good.

CLINICS WITHOUT UNIVERSITY TYPE TEACHING

The second best group of surgeons are fed to the public by the clinics without university-type teaching. In these the Halsted residency does not exist because the material is mainly private patients. It is replaced by a fellowship, or quite often the term "residency" is incorrectly applied. The period of training is shorter, and the mass of material often larger than in the university clinic. The trainees are allowed very little ward or operating room responsibility of their own. The patients are distinctly not the trainee's. Surgeon-patient relations and advancement in responsibility of care can reach only to a degree, rather than to completion of these very essential requirements for the thorough training of the surgeon. The candidate has ample opportunities to observe, study, and do the simpler forms of the work on these patients, and under excellent supervision. He is allowed to open and close wounds, do dressings, run the ward, and observe great numbers of cases. Surgical pathology is well presented to him. But he does not have the sole responsibility of care as the resident under the Halsted resident system does.

This surgeon is different in type, therefore, because of the difference in the mode of teaching. The caliber of the candidate is not the same, as recourse to these clinics for training is often precipitated in the candidate's failure to secure an appointment of the Halsted type. Naturally, the university clinics will accept what they believe to be the very top man. But they cannot accommodate all. Therefore, this clinic receives good men, some of the top class, but not the uniformly high caliber as of the university clinic.

He is usually not a good technician unless he has had a chance to perfect his technique by practice outside of the clinic. His judgment wavers, is apt to be poor because of hasty decisions. He is the most dogmatic of the group of younger surgeons observed. He valiantly wishes to carry the flag of his parent clinic, by insisting that only certain methods can be employed, even at a time when the parent clinic has abandoned the method for a newer, more efficacious one. He seems to call upon his memory for what to do rather than the spontaneity of thought and action of the man trained by advancing responsibility. He is aping good surgeons rather than subconsciously following his own individual surgical thoughts. Bewilderment is sometimes seen, but more often an overbalanced, superior attitude drives the man to prevent self-acknowledgment of his failure to function as a matter of ingrained surgical security. This aspect can be most detrimental to his progress because it teaches the man to bluff his way along until his experience will allow this

sense of surgical confidence. Also, it is detrimental to good surgical results. If the chief has not been able to realize this attitude quickly many troubles ensue. On the other hand, this man improves more than any and once past his defensive, superior, bluffing attitude, quickly becomes one of the best surgeons of the group if allowed responsibility under a chief with a sympathetic understanding. He then perceives the fun of surgery and becomes very useful. He never becomes quite as dependable as the university type, but approaches it closely, depending upon the integrities of the individual. These men are interested mainly in statistical clinical research, seldom in animal experimentation. Their imagination and originality are lacking.

They are opportunists in that once a new surgical fad appears they are the first to sense it and take it up with great enthusiasm. Although boasting and impression stamping are common among university trained men with a bit of temerity, they are boldly broadcast by the clinic man in an attempt to seal his surgical presence as one of approval. Diagnostically, he is not good unless one of the conditions studied as pets in his parent clinic is at hand. During the war, at first his emergency experience was rather hectic and presumably new to him, but he learned this aspect quickly and in a short time did it well. He was the most difficult surgeon to teach the sane approach to the problem of débridement. He understood the later reconstructive phases better. He tends to minimize the importance of meticulous surgical technique and frequently is very conscious of the time consumed in an operation. He often decries the fact that it would take a good surgeon one hour to do a procedure that he was accustomed to observe being done in one-half hour and believes, therefore, that the slower operator was not a good one. He is definitely rougher in handling tissues than the university man, and as a young surgeon is sometimes not willing or able to adjust himself to the more gentle way. He is a great medical society meeting man, a good builder of contacts, and has instinct to spread gospel, the contents of which are not clear in his own mind. Beneath the crust these are good surgeons and from observations of their progress in these various institutions one can easily become convinced that if it were possible to add the last two years of any good Halsted residency training to the clinic training presently in vogue, the good men of this group would be top notch in quality. Also, it can be safely stated that a good many of these men left the Army much better surgeons than upon their induction.

GENERAL PRACTICE SURGEONS

Little need be said of the group of general practice surgeons because as a rule the members have had no formal training or, if so, there was no uniformity to the training and it was obtained in a short period with rotating internship, preceptorship, or apprenticeship. They are not good surgeons but an occasional well-balanced man is observed. Very few of course were sent to general hospitals for work in surgery. Some of them are fair "appendix-hernia" types of surgeons, most of whom employ antiquated, rough methods. They demonstrate great respect for the attending danger of surgery and are not anxious to assume responsibility beyond their experience. A fair number are in the older age group and are either fixed in their surgical ways or

resignedly accept their role as surgeons for only minor conditions for which they have a repertoire of stereotyped procedures that they use automatically but in which experience has taught them to have implicit faith. They observe the more difficult surgical work in the institution very much as they would a museum specimen, and obviously do not plan to attempt it on their return to their communities. They know little about surgical diagnosis, anesthesia, or surgical technique. A few ideas of pre- and postoperative care are usefully obtained from them. It is not so difficult to teach these men the problem of débridement, possibly because they realize its use in their practice. One or two men have sought training in institutions following the war. These are the poorest surgeons of the group and cannot be depended upon for surgical responsibility in any other than minor conditions. Actually, a great number of these are general practitioners who do a little surgery on the side. If the few observed are any indication of the surgical value of these men, one must conclude that the methods of training in producing them are decidedly inferior and if possible should be abandoned.

SPECIALTIES

Since Halsted's time, overspecialization has entered the picture of surgical teaching and its influence is now being reflected in the pupils. Formerly, the well-known surgical specialties, namely, genitourinary, ear, nose and throat, eye, orthopedics, and gynecology existed with liberal allocation of some of their simpler cases throughout the specialty designated as general surgery. Today the pigeonholing has increased at the expense of general surgery until there is a virtual dilemma in attempting to organize the pedagogic course of the well-balanced general surgeon. Extinction of the general surgeon must follow if this trend increases, yet obviously the community need of the general surgeon will remain for many decades at least. Depending upon the medical school, neurosurgery, chest surgery, vascular, rectal, abdominal, head and neck, malignancy, sympathetic nervous system surgery, and probably others have appeared to confound the aims of the surgical teacher. In the former group of specialties it is a matter of rotation of the men through the specialty as assistant residents to gain at least a fundamental knowledge of their diagnostic and operative features. This appears to be sound and allows the general surgeon entering communities not staffed by these specialists to function at least safely and judiciously in the most common conditions seen. They, of course, are not as well qualified as the specialty resident, but it is the most feasible solution to the problem. Not all Halsted residencies permit this desirable rotation and the pupils have a very narrow range of operability. Indeed, some of the observations border on the ridiculous. If the present specialization program gains momentum the ridiculous state will certainly be reached, and the fruits of our teaching efforts must be lacking in satisfactorily supplying good general surgeons throughout the country.

Instances depicting this state are being daily observed. The well-trained man capable of doing major abdominal procedures doesn't know what a sprained ankle, knee, back, or wrist means. He understands total gastric resection problems but is poorly informed about fissure and fistula in ano,

hemorrhoids, or pilonidal sinus. He does not know Colles' fracture except by name. A compound fracture cannot be treated by anyone except an orthopedist, yet the Army depended largely upon general surgeons for the great bulk of its orthopedic work. The work was very well done in the Army. The specialist does not know the fundamental physical diagnostic maneuvers of the shoulder, ankle, elbow, wrist, knee, hip, or back, yet the patient must consult him frequently for advice about these regions. Flatfeet is a foreign subject. Good abdominal surgeons are observed who do not understand how to do a decent pelvic examination, and must call the gynecologist to remove an ovarian cyst instead of an appendix producing the symptoms in the right lower quadrant. The gynecologist must call a surgeon if he inadvertently injures a bowel because he is not capable of its repair. The general surgeon must not follow a brain injury for the signs of increased intracranial pressure because the neurosurgeon instead of teaching the pupil to use the not-too-difficult methods of observation with sense has frightened the surgeon to the point of feeling inadequate, and the patient suffers because there is often no neurosurgeon available. The indications and technique of diagnostic and therapeutic burr holes are simple enough to be commonly used by any well-trained general surgeon. Tension pneumothorax treatment should be under control in every general surgeon's mind. Thoracotomy and closed aspiration drainage must be used by the general surgeon because of the paucity and poor allocation of thoracic talent. Amputation of an extremity is a source of amusing controversy. The general surgeon may amputate it for severe infection or traumatic mangling, but the orthopedist otherwise believes it to be in his domain. Consequently, amputation is not well understood by either surgeon or orthopedist. The orthopedist in many instances in military life delegated the problems of amputation to general surgeons, then returned to civilian life to denounce the general surgeon's interest in the subject. The oncologist desires all tumors in his section and offers to rotate surgeons through his subject, but there are so many special sections that the period of time must be relatively short if men are to rotate through all specialties. Some of these so-called "cancer surgeons" observed know the problem of melanoma well, but state that a radical operation for cancer of the breast can be done without bothering the pectoralis minor muscle, and their idea of radical surgery is really a minor procedure compared to the radical cancer surgery of the well-trained general surgeon. The cancer specialist cuts triumphantly across neoplasm; the good general surgeon thinks he has failed miserably if he does so. The cancer specialist works under the impression that he will remove all he can with ease and destroy the remaining neoplastic disease with radiation, although the particular type of neoplasm might not be amenable to radiation according to the best standards of radiotherapists.

There are other examples but nothing is gained by compilation. This discourse does not deal with the present controversy of overspecialization, but the previously mentioned facts observed by working with these men are examples of the dangers existing in the modern teaching program for general surgeons. The section training, although excellent it may be in the short time available, produces several detrimental aspects to the teaching of surgery.

1. The resident is aware of the fact that none of the specialists' problems will be admitted to his wards. Therefore, the student resident is robbed of the opportunity to develop himself diagnostically as well as if some of all general surgical problems are allowed his observation and study.

2. When he returns to the general surgical section for the final months he sees no traumatic head or extremity conditions, no chest conditions, no perivascular conditions, no tumors, etc., and, accordingly, ceases to study and think about these conditions. In a short period his unfamiliarity with some of these subjects results in lassitude, inertia, and eventual abolishment from his mind many conditions in which he should be well drilled. In other words, we teach him intensively in the sections so that he may return to general surgery and forget them.

3. Some of the specialty teachers have so impressed the young resident with the magnitude of his subject that the student leaves the section with an attitude of awe, respect, admiration for his teacher, and regret that he the student cannot really learn something worth while about the specialty. This attitude is without question responsible for the subsequent fright and "hands off" policy of the resident surgeon.

These comments are not to be construed as derogatory for the development of specialties in surgery. If teaching is not a part of the institution's program, it little matters. But if teaching is attempted and professed, it may well appear that a rejuggling of our specialty schedule to some extent at least is necessary if it is hoped to graduate well-trained surgeons. The problem is a serious one demanding current consideration.

"I WANT MY BOARDS"

The recognition of the Board certificate is certainly sound, desirable, and if continued free of political manipulation will undoubtedly better the surgical population throughout the land. Its effects will be of inestimable value. But it has added one serious blow to the philosophical attitude of many men who are seeking training in surgery. The historical episodes of men performing feats of self-denial and sacrifice, who in the pre-Board era would undergo hardships to train themselves properly in this dangerous form of therapy, are numerous. They realized that there was no rosy path to satisfactory development of surgical diagnostic and technical skill. Surgeons are not born today; they are made by hard work, study, and repetition of technical and all other phases of surgery until the young student blossoms as a man of surgical poise, with the knowledge, experience, and skill to substantiate this desired state.

The difference between the early trainee and a great number of them today is great. In the Army hospitals huge numbers of men sought aid under the guise of training when actually it was later found that they were accumulating time and perhaps some knowledge "toward my Board." The university clinics and Board-recognized Veterans Administration hospitals are besieged with stacks of applications from candidates for residencies. Many frankly discussed matters of further training in Army military hospitals. After interviewing several hundred of them, the distasteful truth reveals the fact that

the man who really desires training is a rarity. Those interviewed are not necessarily the low men in the class, but are in the top third of the class from the best medical schools in our country. The frequent response to the query of purpose of application is, "I want my Boards," "I need two more years for my Boards," "The Board tells me I have to have two years and six months," etc.—and one gains the impression that the majority mean just that. Probably the influence of the Board is extremely good because without it these men could adopt the age-old adage that "I have a medical diploma and license which give me the right to operate, too." The sad implication exists in the fact that these men do not seek a position to train themselves well and do not realize that if good training is obtained their Board certificates will surely follow. They apply for the Board and not for the training. Their actions justify these comments. Other observers may state that this attitude is forced upon the men in the postwar confusion. This is not true, because the younger Army Specialized Training Program applicant demonstrates the attitude in the same manner as his war-torn, surgically frustrated predecessors. These examples tend to demonstrate these points:

1. The man is unwilling to observe, study, and work on cases day and night if that is necessary. He does not want to be bothered with what he can learn at night, and feels quite satisfied with diurnal opportunity only. He is approaching mentally the forty-hour week for learning. He says he has finished work at 5:00 P.M.—instead, he is definitely "through" at 5:00 P.M., and thinks little about surgery and its problems until the next day unless driven to it.

2. He feels no inadequacy or chagrin about missing a diagnosis, an operative indication, an important operation, or follow-up study because of his inertia or apparent disinterest.

3. He believes it is unnecessary for him to observe a sick patient continuously, or to perform laboratory tests except those required, or properly to examine physically a condition for which he depends upon the laboratory, x-ray examination, or other device to clarify the diagnosis and tell him the proper procedure. He demonstrates no alarm when he fails to solve logically a problem, because that problem required the utilization of his knowledge, skill, experience, and common sense rather than a test tube method. He adopts the attitude that if he missed the point in the case that inevitably all others would miss the point, and does not recognize the worthiness and skill required by the one who solves it for him. The correct solution in the hands of the second surgeon becomes a matter of luck. He does not recognize the fact that the power of observation has clarified many problems and does not attempt to labor to better his power of observation.

4. He is thoroughly convinced that he should learn the subject in a much shorter period of time, and would not linger longer in training if the board did not demand it.

5. A smaller group feel that to learn operative technique is all that is necessary for a surgical education.

6. He is not developing as keen a sense of responsibility in the care of his patients as his predecessors.

7. He is eager to be spoon-fed, shown movies, and given lectures, and does not admit in his mental attack that these are only guides to the opportunity awaiting him for self-advancement in the outpatient clinic, the ward, and the operating room.

8. Last, he wishes to carry the mantle of senior surgical resident without developing himself in a way to justify the undertaking of that responsibility.

9. He is training himself to pass a Board rather than the most successful satisfaction of training himself to be the best surgeon he can make out of himself.

These attitudes are, of course, not applicable to all residents, fortunately, but they are observations that are real, too numerous, and are contagious. A great many men of this caliber pass the Boards because, recognizing their deficiencies, they study arduously and assemble a great mass of facts which are useful in passing an examination; but this knowledge is short-lived because it is not a part of the man but rather a lever for Board-passing. It is also a matter of frequent observation to notice that the well-trained surgeon will often not cram for a Board examination because he knows he deserves the certificate, and occasionally fails, where, conversely, the poorly trained man will pass without as much proportional failure.

CONCLUSION

An analysis of these observations cannot definitely point to a correction of what may be lacking in our surgical teaching. It suggests:

1. That in certain institutions our teaching prowess gained in momentum during the pioneer days of the Halsted resident system.

2. That this efficient system of teaching gained widespread adoption and produced a great number of well-trained surgeons.

3. That great variation of the method exists in the teaching policies of the institutions professing its use.

4. That pupils from these schools in the great experiment of work observed in our Army and Veterans Hospitals demonstrate varying degrees of surgical proficiency which closely parallel the teaching merits of the parent school.

5. That training in our large nonuniversity clinics is excellent to a certain period of development of the surgeon, but lacks the advancing responsibility to mould the finished surgeon.

6. That preceptorship and apprenticeship are not producing good surgeons.

7. That overspecialization has detrimentally altered the training of a well-balanced general surgeon.

8. That the Board certificate, although definitely improving the standard of surgical practitioners, is unknowingly and detrimentally influencing the attitude of men undergoing surgical training.

9. That serious consideration and action on the part of surgical teaching institutions be employed to offset the ultimate decline in caliber of our finished surgical resident.

EVOLUTION OF TREATMENT OF CAPILLARY HEMANGIOMAS OF THE FACE WITH FURTHER OBSERVATION ON THE VALUE OF CAMOUFLAGE BY PERMANENT PIGMENT INJECTION (TATTOOING)

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THE successful obliteration of capillary hemangiomas of the face long has presented a challenge to the medical profession. The variable popularity of the myriad treatments of the conservative type is mute evidence that none of these have been rewarded regularly by success. The fact that capillary hemangiomas do not undergo malignant change seems to increase the therapeutic challenge presented by the unfortunate wearer of the birthmark. Conservative methods of treatment have been directed at the destruction of the lesion, its obliteration by fibrosis of the abundant capillaries resident in the derma or in the subdermal tissues. Among such methods of treatment are the following: electrodesiccation, cauterization, distance application of ultraviolet light, carbon dioxide snow, liquid air, ignipuncture, electrolysis, Kromayer therapy, x-ray therapy, and radium therapy. Since such treatments must be applied to the lesion through the overlying skin, it is easy to understand why scarring, the result of injury to or destruction of the skin, follows so often. This objection also is relevant to the surgical attack upon the lesion for it is not possible to excise these capillary hemangiomas without sacrifice of the overlying skin.

My experience in the management of patients with port-wine stains covers a period of twelve years during which these patients have been observed in the plastic surgery clinic of The New York Hospital. The large number of patients who gave history of a series of treatments of the conservative type as listed in the preceding paragraph and whose lesions either had not been effaced or had been replaced (therapeutically) by a scar more seriously disfiguring than the original lesion, led me at first to the surgical excision of capillary hemangiomas. Advances in the technique of tissue shifting and grafting seemed to offer promise. However, the replacement of a large vascular lesion of the derma with a free graft of skin failed to provide the patient with the ideal result for, often, the graft appeared as a facial blemish no less noticeable than the port-wine stain. In recent years there has been a trend away from the use of large free grafts, the advancement of facial and cervical skin in several successive operations being employed in its stead. For smaller lesions the advancement of regional flaps is ideal. In the excision of the larger lesions usually it is necessary to employ small free grafts to surface residual defects about the eyelids or mouth. However, small grafts of suitable matching color may be obtained readily from postauricular areas, the eyelids, or the supraclavicular areas. There has been recent reactivation of interest in another conservative method of management, namely, tattooing, or the injection of permanent, insoluble pigments

into the derma overlying the capillary hemangioma. The use of this permanent camouflage for port-wine stains, the only objectionable feature of which is their color, was suggested first in 1835 by Pauli.[1] In 1946, Brown, Cannon, and McDowell[2] reactivated interest in the use of this treatment for capillary hemangiomas and in 1947 Docktor and I[3] reported seven cases in which the treatment had successfully disguised the color of these lesions. The management of twenty-eight cases up to the present time has not dampened enthusiasm for the tattoo treatment. However, experience has been gained which indicates that not all port-wine stains respond equally as well to their camouflage by tattoo. The reason for this lies in the basic difference in the pathology of the lesions. Andrews[4] classified capillary hemangiomas as (a) subepidermal, those in which the abnormal capillaries lie under the epidermis in the subpapillary zone of the skin; (b) dermal, those in which the abnormal capillaries are chiefly in the midcutis, and (c) subdermal, those in which the abnormal capillaries are in the subcutaneous tissue, subadjacent to the derma. Since the inert pigments used in tattooing must be deposited in the derma if they are to remain permanently, it is apparent that this can be accomplished with ease in the subdermal variety of port-wine stain, effectively though less easily in the dermal variety, and not at all effectively in the subepidermal type. It is this variation in location of the abnormal capillaries which accounts for the differences in response of port-wine stains to camouflage by tattoo.

Since experience in the management of port-wine stains in the plastic surgery clinic of The New York Hospital has evolved according to a pattern which parallels the evolution of treatment of these lesions, four illustrative cases have been selected for report herein. These are examples of (a) excision of the port-wine stain and replacement by free whole-thickness graft of skin, (b) gradual partial excision with advancement of skin of the face and neck and with use of free whole-thickness skin graft to replace residual lesion, (c) partial excision and advancement of skin of the face or neck with tattooing of residual hemangioma, and (d) the camouflage of the entire lesion by tattooing.

CASE REPORTS

Excision of Port-Wine Stain and Replacement by Free Whole-thickness Graft of Skin

CASE 1 (N. Y. Hosp. No. 227002).—R. S., a 20-year-old girl, presented herself for treatment in February, 1939. The lesion was the dermal type of capillary hemangioma and it extended irregularly over an area of the left cheek and left upper lip, measuring 3 by 7 cm. (Fig. 1, *A*). Six radium treatments had been given at another institution six years earlier. There had been no improvement in the appearance of the lesion following this treatment. At operation on Feb. 22, 1939, the lesion was excised and a patterned whole-thickness graft of skin, cut from the lateral abdominal region, was applied. The graft was a success but its failure to match the color of the skin of the face left the patient with a deformity no more desirable than the original port-wine stain (Fig. 1, *B*). The patient found it necessary to continue the wearing of heavy cosmetics in order to hide the appearance of the graft.

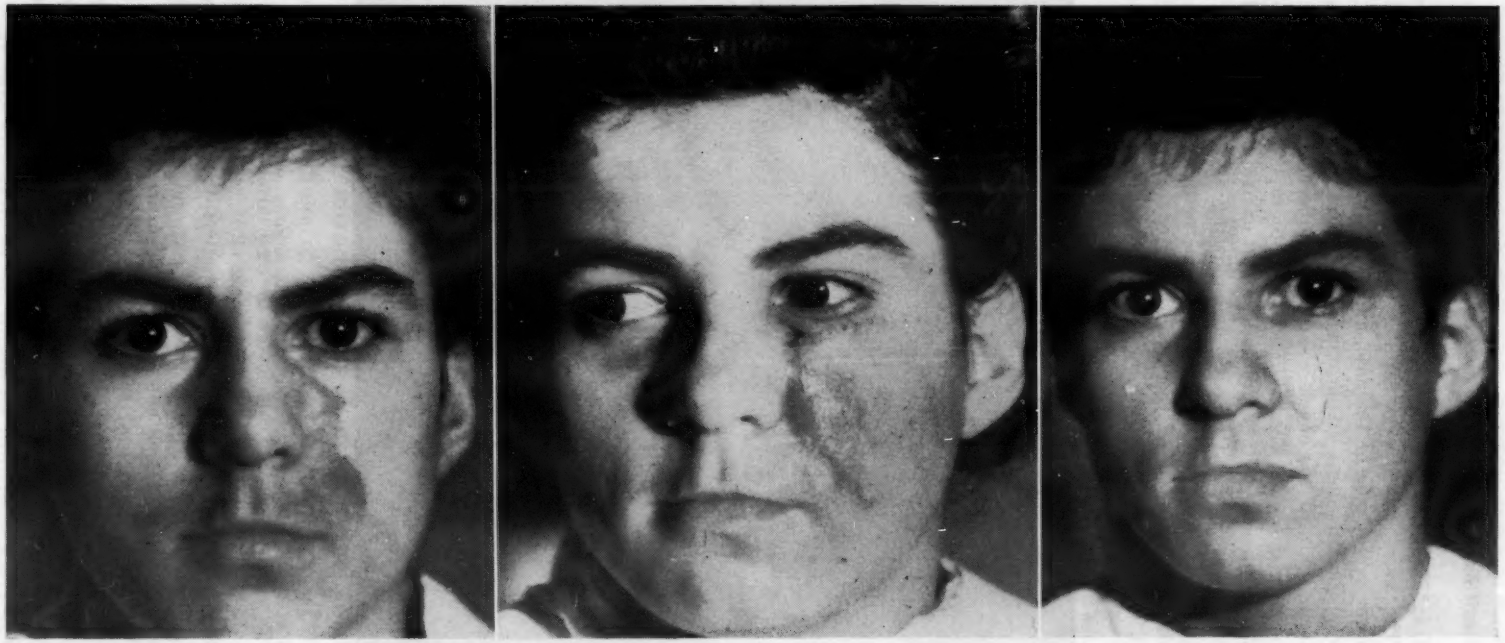
In 1947, following the development of the coloring of skin grafts by permanent pigment injection, this patient was recalled to the clinic. In two treatments, flesh-colored tints were tattooed into the derma of the graft so that it matched the color of the skin of the face very well. Still, the "patched" appearance of the face left the result somewhat short of ideal (Fig. 1, *C*).

A. *B.* *C.*

Fig. 1 (Case 1).—*A*, Dermal type of capillary hemangioma of the cheek. *B*, Appearance after excision of the capillary hemangioma and replacement by a free whole-thickness graft taken from a protected area of the surface of the body. Note that the failure in color match represents a facial blemish no more desirable than the original port-wine stain. *C*, Appearance after tattoo treatment of the skin graft by injection of permanent pigments (flesh color) into its derma.

A. *B.* *C.*

Fig. 2 (Case 2).—*A*, Capillary hemangioma of the subepidermal type over the right cheek, lower eyelid, side of nose, and upper lip. *B*, Appearance after first stage of gradual partial excision with medial advancement of skin of the cheek. *C*, Appearance after excision of the residual capillary hemangioma of the lower eyelid and nose and of the upper lip. The defects after excision were surfaced with whole-thickness grafts cut from behind the ears. The color match was ideal.



A. *B.* *C.*

Fig. 3 (Case 3).—*A*, Dermal type of capillary hemangioma of the cheek. *B*, Appearance after excision of the major portion of the lesion. By undercutting and advancement of the malar skin the line of suture was brought directly into the nasolabial fold. Since further excision with primary suture might result in distortion of the lip, the residual angioma medial to the nasolabial line was treated by tattoo. *C*, Appearance after permanent camouflage by tattoo of residual capiliary hemangioma of the upper lip, medial to the nasolabial fold.

Gradual Partial Excision of Large Port-wine Stain With Advancement of Skin of the Face and the Use of Small Free Whole-thickness Skin Grafts to Replace Residual Lesion

CASE 2 (N. Y. Hosp. No 451337).—M. P., a 20-year-old girl, presented the appearance shown in Fig. 2, *A*. The lesion was a large capillary hemangioma of the subepidermal type over the right cheek, lower eyelid, side of the nose, and the upper lip. On July 31, 1946, first stage gradual partial excision was done. Approximately 2.5 cm. of transverse measurement of the lesion was excised. Skin of the cheek was widely undercut and advanced medially. The extent of the excision is shown in Fig. 2, *B*. This photograph was taken after this first operation. On Sept. 25, 1946, second stage gradual partial excision was done. The central third of the lesion was excised and, after wide undercutting of facial and cervical skin, the lateral cutaneous margin was approximated to the skin of the side of the nose. On Dec. 4, 1946, the residual hemangioma of the right lower eyelid and the lateral aspect of the nose were excised. They were replaced by a whole-thickness graft measuring 4 cm.

A. *B.*

Fig. 4 (Case 4).—*A*, Extensive subdermal capillary hemangioma of the neck and cheek. *B*, Appearance after permanent camouflage by nine tattoo treatments.

in its greatest vertical dimension and 5 cm. in its greatest transverse dimension. This graft was taken from the posterior aspect of the right ear and from the cephaloauricular angle. Its pattern was such that it was not possible to suture the margins of the donor wound without distortion of the external ear. Because of this, a thick-split graft was cut from the upper thigh and applied to the donor wound. Interpalpebral synechiae were established. On Jan. 8, 1947, the residual hemangioma of the upper lip was excised. The defect was covered with a second whole-thickness graft taken from behind the left ear. This graft measured only 2.5 by 1.5 cm. and its donor wound was closed by suture. On Feb. 3, 1947, the synechiae holding the eyelids closed were divided. The appearance of the patient in March, 1947, is shown in Fig. 2, *C*. The result was quite satisfactory since small grafts obtained from behind the ears matched the color of the skin of the face.

Partial Excision of Dermal Capillary Hemangioma of the Cheek With Advancement of the Skin of the Face and Camouflage of Residual Hemangioma by Tattooing

CASE 3 (N. Y. Hosp. No. 460250).—C. F., a 16-year-old girl, presented a capillary hemangioma of the left cheek of the dermal type (Fig. 3, *A*). At operation in December, 1946, all of the lesion with the exception of a small area on the upper lip, medial to the nasolabial line, was excised. The skin of the cheek was undercut widely and advanced to a line of suture which was placed exactly in the nasolabial line (Fig. 3, *B*). Further excision with primary suture might have endangered full function of the lips. The residual hemangioma was camouflaged by tattooing (Fig. 3, *C*). The inert pigments blended well with the adjacent skin and the result was ideal.

Permanent Camouflage of Large Subdermal Capillary Hemangioma of the Cheek, Lips, and Neck by Tattoo

CASE 4 (N. Y. Hosp. No. 481788).—R. M., a woman 27 years of age, presented an extensive port-wine stain of the subdermal type over the left cheek, chin, and neck (Fig. 4, *A*). It was treated by the injection of inert pigments (tattooing) into the derma overlying the lesion. This lesion, the surface area of which was seventeen square inches, was satisfactorily camouflaged in nine treatments given at two- to three-week intervals (Fig. 4, *B*). The treatments were given without anesthesia. Pigments injected were white mixed with very small amounts of green and brown. The tattoo treatment was especially adaptable to this subdermal type of port-wine stain.

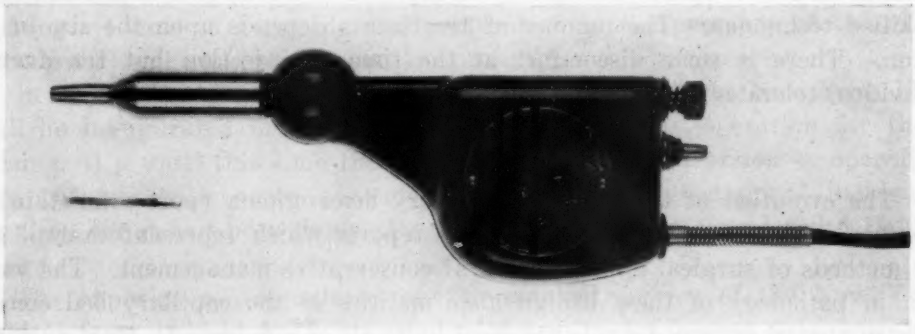


Fig. 5.—Electromagnetic device with five small needles which is used in the permanent pigment injection (tattooing) of capillary hemangiomas. (From Conway and Docktor, Surg., Gynec. & Obst., 1947.)

TECHNIQUE

The technique of intradermal injection of insoluble pigments (tattooing) for permanent camouflage of port-wine stains follows. The area to be injected is washed with soap and water, painted with aqueous solution of merthiolate, and draped with sterile towels. Instruments and pigments are sterilized. The technician wears sterile rubber gloves. The area should be free from infection. It has been found expedient to use the standard electromagnetic device to which six needles are attached. This is shown in Fig. 5. With sterile water the pigments are mixed into a thick paste which is picked up in the cup of the needle holder when the needles are withdrawn into its shaft. The current which causes rapid oscillation of the needles is operated by a foot control. The needles are inserted into the skin at an angle of approximately 60 degrees so that the pigment will be injected obliquely at varying depths in the derma. The basic

pigments which are in use at present include the following: white, titanium (or zinc oxide U.S.P.); yellow, oxide of iron; red, mercury sulfide (or cinnabar); blue, cobalt blue; black, black oxide of iron; green, hydrated chrome oxide.

Combinations of these pigments usually will produce the desired tints. In addition ocher, sienna, and other earthy metallic oxides may be used. All of these pigments are inert and insoluble. They may be sterilized in 70 per cent alcohol or may be autoclaved. The mixture of colors must be suited to the individual case. For the covering of capillary hemangiomas, white is the basic pigment, occasionally mixed with a very small amount of red, green, or brown. At the first treatment, a small area is injected and a record is kept of the color combination. Three to four weeks are allowed to elapse before judgment is passed on the effect of treatment. Usually there is some absorption and some desquamation of pigment. A second or a third treatment over the same area may be necessary before the desired result is obtained. Following the treatment a sterile dressing is applied. The patient is seen in twenty-four hours, at which time a crust is present over the area which has been injected. As this peels away during the next six to ten days the effect of the injection may be observed. Once the proper mixture of pigments is decided upon, treatments may be given at two-week intervals until the skin over the entire lesion has been injected. An area of 2 to 3 square inches may be injected in about forty-five minutes by a skilled technician. The number of treatments depends upon the size of the lesion. There is some discomfort at the time of injection but the average individual tolerates this without anesthesia.

SUMMARY

The evolution of treatment of capillary hemangioma (port-wine stain) of the face is presented through four case reports which represent examples of the methods of surgical approach and of conservative management. The variation in pathology of these benign abnormalities of the capillary bed consists only in that they may be subepidermal, dermal, or subdermal. This variation must be taken into consideration in the plan of treatment. The tattoo treatment results in effective permanent camouflage of port-wine stains of the dermal or subcutaneous variety. The subepidermal variety is effectively eradicated only by excision of the port-wine stain and reconstruction of the face by advancement of regional skin supplemented on occasion by free, whole-thickness graft of skin.

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THE SURGICAL TREATMENT OF ACUTE CHOLECYSTITIS

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THE early surgical treatment of acute cholecystitis, although still controversial in some medical circles, is generally accepted today as contributing to the best interests of the patient. One of the early advocates of this therapy was George J. Heuer, in whose honor this volume is dedicated. His early training under William S. Halsted provided him with his first opportunity for seeing the uneventful postoperative course of a patient operated upon for acute cholecystitis. This was followed in turn by his own successful experience of operating upon such patients in a relatively limited number before he went to Cincinnati. As professor of surgery at the University of Cincinnati and surgeon-in-chief to the University Hospital, an opportunity was afforded him again to put into practice what he believed to be a sound policy in the treatment of these patients in the early acute phase of the disease, and over a period of eleven years he demonstrated that both morbidity and mortality rates were extremely low for those patients with acute cholecystitis who were operated upon when well prepared. At the same time, he observed that the gall bladder in acute cholecystitis might proceed in its pathologic course to gangrene and perforation in the presence of subsiding and minimal signs and symptoms.

In 1932, when Dr. Heuer became surgeon-in-chief of the New York Hospital, he inaugurated in this hospital a policy of early operation for these patients. Up until this time there had been a general aversion to operating upon patients with acute cholecystitis and only an occasional incidental operation for it had been done. Dr. Heuer's policy was considered a radical change.

The experience accumulated on the surgical service of the New York Hospital from 1932 to 1947, a period of fifteen years, serves as a basis for this discussion. It is an admirable record. The accomplishment is by and large the result of the policy established by Dr. Heuer and constituted a departure from the custom of the community of New York City.

This policy has resulted in an experience of 586 patients with acute cholecystitis being treated surgically over a fifteen-year period. From an over-all standpoint the results have been gratifying, but there is room for improvement, since seventeen of these patients died following operation. Some of them might have survived had operation been performed earlier—either years earlier when the biliary tract disease was in its early phase, or days earlier before the acute attack had progressed to a stage where complications such as gangrene and perforation had taken place. The mortality rate of 2.8 per cent should therefore be reduced in the future. Acute cholecystitis is a phase of gall bladder disease that may occur in the early decades of life. In women, in particular, it may first appear during or following the first pregnancy and recur at varying intervals thereafter. It may be said that onset takes place in an older age group in men, but no age is exempt. Over 95 per cent of the

patients operated upon have had gallstones, which would indicate them as the most important single factor in the precipitation of acute episodes. The diagnosis is not difficult.

Surgical treatment of acute cholecystitis at the New York Hospital provides for operation when the patient is adequately prepared, unless some coexisting condition not immediately reparable contraindicates operation. The operation of choice is cholecystectomy, and this was accomplished in 513 patients, or an incidence of 87.5 per cent. Cholecystostomy is a compromise procedure, but when indicated, may be a lifesaving one, and has been resorted to in seventy-three cases, or 12.4 per cent. If there is evidence suggesting common duct obstruction due to stones, then the procedure of choledochotomy is added. Fortunately, this increase in operative burden has been employed in only forty-five patients, or 7.6 per cent. The procedure to be employed is decided upon during the operation. The patient's immediate welfare is always the first consideration, to secure the greatest possible benefit with the least hazard. At the same time, the indicated procedure is done even though it may add some risk, as for example exploration of the common duct when obstructive jaundice believed caused by calculi is present.

TABLE I. ACUTE CHOLECYSTITIS, NEW YORK HOSPITAL (SEPT. 1, 1932 TO SEPT. 1, 1947)

Total cases	586
Deaths	17
Mortality rate	2.8%
Operative Procedures	
Cholecystectomy	513
Cholecystostomy	73*
Common duct exploration	45

*This number constitutes 12.4 per cent of total operations.

Cholecystostomy is clearly indicated under certain circumstances, such as when the patient is too ill to withstand a cholecystectomy, or when cholecystectomy presents too great difficulties. In the older age group, where extreme debilitation is encountered most frequently, and among those whose illness is the result of too long delayed operation, the simpler procedure of cholecystostomy should always be employed. It can be done under local anesthesia, disturbing the patient very little. Not only may it be lifesaving, but decompression of the biliary tract may avert progressive liver damage if complete biliary obstruction is present. In seventy-three patients, cholecystostomy was performed, with a mortality of eight, or 12.8 per cent. This high mortality rate is indicative of the serious condition of the patients when operation was undertaken.

The gross appearance of the presenting pathologic changes contributes to the type of operation to be done. For example, if gangrene and perforation accompany generalized peritonitis, the operative procedure should be limited to cholecystostomy and drainage of the operative area. If there are gangrene and perforation which have resulted in localized peritonitis or abscess in the region of the extrahepatic portion of the gall bladder, then cholecystectomy or cholecystostomy may be done according to the ease with which the pro-

cedure can be carried out. If there is extensive abscess formation, or if the omentum is adherent and obscures the structures in the region of the biliary fossa, it is probably the better part of wisdom to leave these undisturbed and to limit the procedure to cholecystostomy. Also if the patient is unusually ill and if postoperative complications appear in the offing, cholecystectomy should not be attempted. On the other hand, a small abscess, the result of perforation of the gall bladder, is no contraindication to cholecystectomy. It is not an infrequent experience to encounter abscesses located between the liver and the gall bladder wall. The patient with simple acute cholecystitis and/or hydrops of the gall bladder is generally best treated by cholecystectomy, which is readily accomplished.

Common duct exploration in acute cholecystitis has been limited in our clinic to those patients with unequivocal indication of common duct obstruction, and a distinction should be made between a mild degree of jaundice associated with inflammatory reaction throughout the bilary tract which is frequently associated with acute cholecystitis and true common duct obstruction. The incidence of postoperative complications in patients requiring common duct exploration appears higher than when such is not necessary. At the same time, it may be said that these patients are usually in the group that is more seriously ill. For the jaundiced patient that is extremely ill, decompression, that is, cholecystostomy, may be utilized as a compromise immediate procedure, having in mind of course, following the subsidence of the jaundice, the exploration of the common duct with the patient in a greatly improved condition. The presence of jaundice requires the determination of the blood prothrombin and the evaluation of any bleeding tendency, and in the presence of acute disease time may not be afforded for this. Therefore, for such patients the use of whole blood transfusions and parenteral administration of vitamin K may prevent serious postoperative hemorrhage. This same group of patients often have liver damage and special consideration must be accorded them as indicated.

The common duct was explored in forty-five of these patients, an incidence of 7.6 per cent. Stones were found in thirty of these, or an incidence of 66.6 per cent of those explored. The exploration of the common duct in the patient without stones does not apparently add materially to the postoperative complications. This should be kept in mind when deciding whether or not to explore the common duct, because failure to remove a common duct stone may lead to catastrophe. It has been our policy in such a situation to explore the duct when in doubt.

Cholecystectomy is the operation of choice in acute cholecystitis. The removal of the gall bladder interrupts the pathologic process and averts the danger of gangrene and perforation. This procedure is sometimes contraindicated, as:

1. In the presence of peritonitis due to perforation of the gall bladder. These patients are gravely ill and the simplest procedure to tide them over the immediate situation is indicated.

2. Conditions which make it difficult to identify the important structures of the biliary fossa. The acutely inflamed gall bladder, with many adhesions between it and the adjacent viscera, may so distort the anatomic relationships that they become obscure, and as a result injury to the hepatic vessels or the common duct may result.

3. The presence of a severe jaundice caused by obstruction in the common duct is a contraindication to an extensive operative procedure. It is usually better to drain the gall bladder and thereby relieve the jaundice than to subject the patient to a long procedure that may be required in searching for a stone.

4. In those patients whose general condition is so grave that a general anesthesia and a prolonged operation are not justified. This is seen most frequently in the aged and debilitated, when the acute cholecystitis is superimposed upon such systemic disorders as cardiovascular and renal disease. Under such circumstances a compromise must be sought in the form of surgical treatment that adds as little a burden as possible to the individual and yet tides him over the immediate crisis.

TABLE II. ACUTE CHOLECYSTITIS, NEW YORK HOSPITAL (SEPT. 1, 1932 TO SEPT. 1, 1947), IN PATIENTS 50 YEARS OF AGE OR OVER

Total cases	205
Deaths	13
Mortality rate	6.1%
Operative Procedures	
Cholecystectomy	165
Cholecystostomy	40*
Common duct exploration	24

*This number constitutes 19.5 per cent of total operations.

Over the fifteen-year period, 586 patients with acute cholecystitis have been treated surgically. During this same period a total of over 2,600 patients were treated surgically for biliary tract disease. Of the 586 patients, 205 were 50 years of age or over. In this group of 205 there were 13 deaths, or a mortality rate of 6.1 per cent; 165 were subjected to cholecystectomy, 40, or 19.5 per cent, to cholecystostomy. Twenty-four had, in addition, exploration of the common duct. The mortality rate of 6.1 per cent in this group of patients indicates the decidedly greater risk associated with them than with those under 50 years, who had a mortality rate of 1.04 per cent.

In patients over 50 years of age, acute cholecystitis is a more serious disease than in the younger group. The mortality rate is over five times greater. It has been our experience that changes in the vascular system, namely, arteriosclerosis, hypertension, and diabetes, are greater in those who have biliary tract disease than in a corresponding number without it. The trend of our population toward the older age group indicates that we may anticipate an increasing number of these geriatrical problems unless they can be reduced by preventive surgery. For biliary tract disease, it means operating in the earlier decades when acute cholecystitis represents an early phase of the disease. If our contention is correct, a deleterious effect upon the vascular system may be interrupted.

TABLE III. SUMMARY OF DEATHS AFTER OPERATION

	SEX	AGE (YR.)	BILIARY DISEASE HISTORY (IN YR.)	DURATION OF ATTACK	JAUNDICE	FINDINGS	OPERATION	CAUSE OF DEATH
1	F	66	8+	3 days	+	Acute cholecystitis with perforation, peritonitis	Cholecystectomy with drainage	Peritonitis
2	F	67	4+	7 days	0	Acute cholecystitis with gangrene	Cholecystostomy	Peritonitis, bacteremia
3	F	50	20+	10 days	+	Acute cholecystits, cholelithiasis, common duct obstruction	Cholecystostomy	Bacteremia, stone in common duct, thrombosis hepatic artery
4	M	72	7+	8 days	+	Acute cholecystitis, cholelithiasis	Cholecystostomy	Hepatic failure, biliary cirrhosis
5	F	57	Inadequate history	4 days	0	Acute cholecystitis, cholelithiasis	Cholecystectomy, drainage abscess	Subhepatic abscess*
6	F	70	12+	8 hr.	0	Acute cholecystitis, cholelithiasis	Cholecystectomy	Coronary occlusion, cardiac failure
7	F	64	2+	2 days	+	Acute cholecystitis	Cholecystectomy with drainage	Adrenal insufficiency
8	F	54	4+	3 days	+	Acute cholecystitis, common duct obstruction	Cholecystectomy, common duct exploration	Leakage from cystic duct, subphrenic abscess, pancreatic necrosis
9	F	72	?	3 days	0	Acute cholecystitis, carcinoma of cecum	Cholecystectomy, ileocolostomy	Intestinal obstruction, hypertensive cardiac disease
10	M	69	8	2 days	+	Acute cholecystitis	Cholecystostomy, peritoneal drainage	Bile peritonitis
11	F	61	10	5 days	0	Acute cholecystitis	Cholecystectomy	Anoxia, brain damage, anesthesia
12	M	71	Inadequate history	4 days	+	Acute cholecystitis, cholelithiasis, perforation of gall bladder	Cholecystostomy	Peritonitis, uremia*

*No autopsy.

There are those who question the advisability of operating upon the patient with acute cholecystitis. These figures, however, seem to justify the policy to which we have adhered for several years. And what is more important, we believe we have saved patients from the catastrophe of perforation following gangrene. This is in direct contrast to the so-called conservative policy that considers such patients to be medical problems and leaves them in their homes where complications may develop and be unrecognized. We consider these patients as surgical and admit them to the hospital where they are under constant observation, and where laboratory data, temperature records, and personal observation by more than one individual are of greater value in determining the course of events in the pathologic process that is going on. When such a patient is in satisfactory condition for operation, it is then deliberately done.

It should be stressed that very few patients with acute cholecystitis fail to give a long history of symptoms relative to the biliary tract. For those over 50 years of age there is often a history of disease of over twenty years. For those under 50 years, it is much less. However, the young woman recently pregnant who enters the hospital with acute cholecystitis—and I look upon her as an example of the early phase of chronic biliary tract disease—usually gives a history of indigestion, abdominal discomfort, and sometimes nausea and vomiting dating back to the early weeks of her first pregnancy. Many of these patients on x-ray examination are found to possess a nonfunctioning gall bladder or a poorly functioning one containing stones. Their symptoms previously had not been acute and they tolerated them. When they have acute attacks, they consult a physician. In the years past, they were commonly advised that they would recover, and most of them did, but only to have one attack after another.

A summary of deaths after operation follows. These twelve of the total seventeen deaths in the series were in patients 50 years of age and over, and one may consider that earlier operation might have reduced this number—years earlier, as far as biliary tract disease itself is concerned, and days earlier in the case of the acute attack.

The remaining 381 of the 586 patients were under 50 years of age. There were 4 deaths, a mortality rate of 1.04 per cent; 347, or 91.1 per cent, were subjected to cholecystectomy, and 33, or 8.6 per cent, were treated by cholecystostomy. Twenty-six, or 6.8 per cent, had in addition to one of the pro-

TABLE IV. ACUTE CHOLECYSTITIS, NEW YORK HOSPITAL (SEPT. 1, 1932 TO SEPT. 1, 1947), IN PATIENTS UNDER 50 YEARS OF AGE

Total cases	381
Deaths	4
Mortality rate	1.04%
Operative Procedures	
Cholecystectomy	347
Cholecystostomy	33*
Common duct exploration	26

*This number constitutes 8.6 per cent of total operations.

TABLE V. SUMMARY OF DEATHS AFTER OPERATION IN PATIENTS UNDER 50 YEARS OF AGE

	SEX	AGE (YR.)	BILIARY DISEASE HISTORY (IN YR.)	DURATION OF ATTACK (IN DAYS)	JAUNDICE	FINDINGS	OPERATION	CAUSE OF DEATH
1	M	41	5	1	+	Acute cholecystitis	Cholecystectomy	Cardiac and renal failure, liver death
2	F	49	15	3	+	Acute cholecystitis	Cholecystectomy	Subdiaphragmatic abscess, peritonitis
3	F	49	12	2	0	Acute cholecystitis, stones in common duct, acute pancreatitis	Cholecystectomy, choledochotomy	Pulmonary emboli 27th P. O. day*
4	M	44	4	10	0	Acute cholecystitis	Cholecystectomy	Hypertension, cardiorenal failure
5	F	49	3	3	0	Acute cholecystitis, cholelithiasis	Cholecystostomy	Coronary occlusion*

*No autopsy.

cedures just listed, exploration of the common duct. This is a far more favorable outcome than our experience with the group of patients over 50 years of age.

In the community of our practice at the New York Hospital, it has become well known among our patients that if they have an attack of acute cholecystitis they will be advised to have the gall bladder removed, unless there is a contraindication. This is a step forward because it interrupts the disease early if acute attacks occur in the late twenties and early thirties. These patients have done remarkably well following operation. Since 1932, we have not lost a single patient under 40 years of age following operation for acute cholecystitis, except one child with acute typhoid cholecystitis. The patients who die following operation are in the upper age group for the most part, and death is the result of complications (often involving the circulatory system) including embolism, the result of a phlebitis. Those patients with chronic biliary tract disease, who have as a complication acute cholecystitis, may have a complication of acute cholecystitis, namely, gangrene perforation, with a resulting local or general peritonitis. There are, we feel, patients who die as a result of complications when treated by the conservative policy in their homes or even in hospitals. The five deaths in the group under 50 years of age, listed in Table V, indicate that the biliary tract disease had been of long standing.

The evolution and development of the surgical treatment of biliary tract disease is not yet complete. Cholecystostomy for the removal of stones had been a common practice prior to Langenbach's report of cholecystectomy for chronic cholecystitis and cholelithiasis in 1884. Not long thereafter, Kümmell (1890) reported an exploration of the common duct with removal of stones. Over the past seventy-five years an increasing experience coupled with improved medical facilities has made diagnosis in biliary tract disease less difficult. As a result, a greater proportion of patients is seen by the surgeon earlier than in years past. Operative procedures are now well standardized, and when carried out in carefully selected and well-prepared patients are associated with minimal risk.

The policy inaugurated by Dr. Heuer and followed by his staff at the New York Hospital over a period of fifteen years has been presented. The results of operating on patients in the younger group in the acute phase of the disease support the contention that this is the optimum time for surgical intervention. Furthermore, operation in the acute phase for those over 50 years will reduce the morbidity and mortality rates of biliary tract disease.

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FURTHER OBSERVATIONS ON THE TREATMENT OF BLEEDING PEPTIC ULCER

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THE principle established in wounds of war and accidents of civil life—that active hemorrhage must be controlled before progress can be made in saving life—is equally applicable in the type of hemorrhage under discussion." In these words, Dr. Heuer summarized his opinion concerning the treatment of a patient who was then rapidly being exsanguinated by a bleeding peptic ulcer. This patient had been admitted to the surgical ward four days previously, several hours after having vomited a pint or more of blood. The day following admission, his condition seemed improved, the blood pressure had stabilized, and he was content with the somewhat restricted diet. Unfortunately, on the following morning when the nurse delivered the breakfast tray, the patient was found pale, anxious, and in a cold sweat. At the sight of food he promptly vomited a basinful of blood. A transfusion restored the blood pressure, but only for a short time, and, in spite of continuous blood administration, the patient gradually failed, lapsed into coma, and died twenty-four hours later—five days after the onset of bleeding. Quite obviously, he had lost blood more rapidly than was possible to replace it. As in the past, it was expected and found at autopsy that the patient had bled from a sizable vessel, the pancreaticoduodenal, which lay in the base of a calloused ulcer on the posterior duodenal wall.

The sequence of events in this patient is typical of several that we witnessed each year under a conservative therapeutic regime for massive hemorrhage. Following the sadly similar results in two other patients admitted to the hospital in successive weeks, Dr. Heuer suggested a survey be made of our results in the treatment of bleeding ulcer, in the hope that from such a study, an improved program of therapy might be formulated for the use of the resident staffs. This first survey[1, 2] not only served to focus attention on bleeding ulcer and emphasize its gravity, but also led us to abandon conservative treatment in favor of immediate operation for certain groups of patients.

The primary purpose of this paper is to compare the results under this more radical therapy (adopted in 1940) with the results under the earlier conservative therapy (1932 to 1939, inclusive). Although such a report is valuable chiefly to those directly concerned with its source material, this one may claim a wider interest since it is free from the variables that distort a comparison of results from different clinics: (1) differences in professional skill, (2) variations in the class of patient, and (3) inconsistencies in the interpretation of what constitutes a severe hemorrhage or a satisfactory

This study was supported in part by the United Hospital Fund of New York.

therapeutic result. In the cases in this report, only the therapy was changed. The patients all were ward patients, all had such severe bleeding that they had to be hospitalized, and their care was directed by supervised resident surgeons, all trained by the same standards.

During the earlier period, from 1932 to 1939, inclusive, all patients admitted because of severe hemorrhage from ulcer (161 in number) were treated in a more or less standard, conservative way. This consisted of complete bed rest, nothing by mouth, adequate sedation, and supportive parenteral fluids until it was evident that the bleeding had stopped. Those who continued to bleed under this treatment or who were near exsanguination on admission also received repeated small blood transfusions. A few patients who continued to bleed after prolonged therapy, five in number, were operated upon as a last resort. During this period, twenty-one patients died—a mortality of 13 per cent—a fair average of other reported results (Table I).

TABLE I. MORTALITY

AUTHOR*	NUMBER OF CASES	DEATH	MORTALITY PER CENT
Aitken	255	27	11.0
Allen and Benedict[3]	138	20	14.5
Babey and Hurst	82	4	5.0
Burger and Hartfall	137	31	22.5
Chiesman	191	48	25.0
Conybeare†	600	22	3.7
Christiansen	289	23	7.9
Davies and Nevin	391		21.0
Fowler and Hurevitz	72	17	23.0
Hellier	202	30	14.8
Meulengracht	273	3	1.0
Thorstad	208	21	10.0
Umber	433	41	9.5
New York Hospital	161	21	13.0

*References in this table accompanied by superior figures will be found in the regular Reference list; the remainder are listed in *References to Table I.*

†Conybeare stated that the mortality from hemorrhage in chronic ulcers is between 5 and 10 per cent.

It was quite obvious that, although most patients recovered satisfactorily under this treatment, a not insignificant number, 13 per cent, would die unless more active measures were taken to control the bleeding.

The first problem was one of recognizing those patients who would not benefit from conservative treatment. Critical analysis of our patients revealed a definitely poor prognosis for two groups: those who failed to improve within twenty-four to forty-eight hours after they had been placed on a strict medical regime (in this series 48 per cent of these patients died if conservative treatment were continued), and those who suffered the first hemorrhage while they were under a strict medical regime for a heretofore uncomplicated ulcer. (In the first period, there were six of these patients, five of whom died under conservative therapy and one of whom recovered following immediate gastric resection for control of hemorrhage.) Since there has been little comment in the literature about the latter type of patient, the following case history may serve as an example.

CASE REPORT

A man, 49 years old, had had recurrent bouts of epigastric postprandial pain for five years. Three days before admission to the hospital, he developed severe, persistent, epigastric pain associated with nausea, but no vomiting, hematemesis, or melena. Physical examination was not remarkable except for tenderness and some muscle spasm in the epigastrium. Hemoglobin was 110 per cent; red blood cells 6 million; stool showed no blood.

A diagnosis of penetrating ulcer was made, and the patient was given a restricted diet with complete relief of symptoms in twenty-four hours.

Seven days after admission, the patient suddenly felt weak and several hours later passed several tarry stools. Twenty-four hours later he felt greatly improved, and the blood studies showed hemoglobin of 60 per cent and red blood cells of 3 million. The condition remained unchanged for four days, when suddenly, on the twelfth day after admission, he vomited about one pint of blood and went into shock. During the next forty-eight hours the patient continued to bleed, and, in spite of numerous blood transfusions, he developed signs of bronchopneumonia and died.

Autopsy revealed a huge ulcer situated on the posterior wall of the duodenum, adherent to the pancreas. The ulcer crater measured 3 cm. in diameter, and in its base was a large eroded vessel, which on dissection proved to be the pancreaticoduodenal artery.

In addition, it was found that the age of the patient might have a significant bearing on the prognosis. In general, the older the patient the higher the mortality,[3-5] in patients under 30 years of age the mortality was 6 per cent, in contrast to 20 per cent in those 50 years and older.

In view of these findings, it was decided that, in the future, any patient who fell into either of the two groups described, particularly if he were over 40 years of age, would be operated upon immediately if the condition in any way warranted the risk. It might be said that an analysis of the clinical course of the patients who had died revealed that, with few exceptions, there was a period when operation might have been done with a reasonable hope of success.

A survey of the period from 1940 to 1946, inclusive, when the newly instituted treatment was followed, showed a most gratifying fall in the mortality from the previous 13+ per cent to 5+ per cent. During this time, 206 patients were hospitalized because of bleeding, 11 of whom died. Of these, 19 were operated upon during active bleeding, with 4 deaths, a mortality of 20 per cent. (Two of these fatalaties were patients operated upon late in the course of the bleeding, after nine and twenty-seven days, respectively.) Of the total, 84 patients were operated upon after recovery from bleeding, with a 3.6 per cent mortality; 96 were discharged from the hospital without operation.

The success of this treatment depends upon (1) an early recognition of those patients who will not respond to conservative therapy, and (2) operation on these patients as soon as possible after the onset of bleeding, preferably within forty-eight hours. It should be emphasized that, once it has been decided to operate for control of active bleeding, any delay with the hope that the patient will spontaneously stop bleeding only increases the risk of surgery.

Finsterer[6] maintained that the optimum time for surgery on the actively bleeding ulcer is within forty-eight hours after onset of hemorrhage. Following that rule, he reported an operative mortality of 5 per cent in contrast to a

30 per cent mortality if operation is delayed. Others, as Gordon-Taylor[7] and Oliani,[8] had similar experience. Our experience is even more striking: 10 per cent mortality for those operated upon early; 70 per cent for those operated upon late.[9] It would almost seem that, if for some reason operation is delayed and is then later contemplated as a means of last resort to save the patient's life, it might be better to hope instead that the patient is one of the 50 per cent who recover on conservative therapy.

As to the type of surgical procedure to choose: even though these patients are critically ill and appear none too robust for extensive operative procedures, gastric resection is tolerated surprisingly well if a large amount of blood is given before, during, and after operation. Certainly, resection is the ideal procedure to insure both immediate control of bleeding and a satisfactory permanent result. Indirect methods, such as gastroenterostomy and plastic procedures on the duodenum, have been found of little value.[10]

In the postoperative period, special effort should be made to restore the hemoglobin to a normal level as quickly as possible. Since the diet is necessarily restricted, and since, in addition, many patients have been on a limited diet for long periods before the onset of bleeding, parenteral vitamins should also be given. Penicillin should be administered both before and after operation.

It is possible at this time also to make a preliminary report on a five-year follow-up study on all patients hospitalized for bleeding. As is well known, a true evaluation of the therapeutic results in peptic ulcer can scarcely be made until after five years of observation, and a longer period is preferable. All the patients reported on in this follow-up study were admitted to the hospital five years or more before because of bleeding; no patient is included in this report merely on the basis of a previous history of bleeding.

Table II summarizes the patients studied. Three groups are of particular interest: (1) of the 134 patients who were discharged from the hospital after recovery from the bleeding without operation, 5 (3.7 per cent) died from

TABLE II. BLEEDING PEPTIC ULCER, FIVE-YEAR FOLLOW-UP

TREATMENT	NUMBER	RESULT	NUMBER
No operation	134	Asymptomatic	32
		Bleeding	66
		Pain	31
		Death from bleeding	5
Gastroenterostomy	14	Asymptomatic	5
		Bleeding	7
		Pain	1
		Death	1
Pyloroplasty	1	Asymptomatic	0
		Bleeding	1
		Pain	0
		Death	0
Gastric resection	53	Asymptomatic	46
		Bleeding	2
		Pain	5
		Death	0

recurrent hemorrhage; 66 (50 per cent) had recurrence of the bleeding; 31 (23 per cent) had sufficient pain to require continued medical therapy; and only 32 (24 per cent) are free from pain and bleeding. (2) In contrast, of the 53 patients on whom a gastric resection was performed, none died; only 2 (3.8 per cent) had recurrence of bleeding; 5 (9.4 per cent) had pain; and 46 (87 per cent) are asymptomatic. (3) Of the 15 patients who had indirect operative procedures performed, such as gastroenterostomy or pyloroplasty, 1 (6.6 per cent) died from recurrent bleeding; 7 (46 per cent) had recurrence of bleeding; 1 (6.6 per cent) had pain; and 5 (33 per cent) are asymptomatic. In a somewhat similar group of 29, who were hospitalized because of bleeding but in whom either a gastroenterostomy or pyloroplasty had been done in the past, it was found that 24 had recurrence of bleeding, 2 had pain, and 3 are asymptomatic.

These findings, and the findings of others,[3, 11, 12] may help to formulate a policy for the management of those patients who have recovered from the hemorrhage that brought them to the hospital. That over 50 per cent of these patients will bleed again, a few fatally, and that 75 per cent will have symptoms that require medical attention, are potent arguments for surgical therapy. However, other factors, such as the duration and location of the ulcer and its previous response to medical therapy, must also be considered. Although each individual case must be judged on its own merits, it would seem reasonable to advise operation on those patients who have been known to have a symptomatic ulcer, particularly if they are men over 40 years of age.

Gastric resection, with an expected satisfactory result in 85 per cent of the cases, certainly offers the best protection against future hemorrhage. Lesser procedures, excluding vagotomy about which we have no information as yet, are patently not advisable. The respective percentages speak for themselves: recurrent bleeding in less than 5 per cent after gastric resection, in contrast to 45 per cent after the lesser procedures.

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ROLE OF THE GLOSSOPHARYNGEAL NERVE IN THE CAROTID SINUS REFLEX IN MAN; RELIEF OF CAROTID SINUS SYNDROME BY INTRACRANIAL SECTION OF THE GLOSSOPHARYNGEAL NERVE

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THE complexity of the anatomic arrangement and the physiologic reactions of the carotid sinus reflex in man have raised many questions, one of which is the role of the glossopharyngeal nerve. In an earlier report[1] it was shown that although certain transitory effects in blood pressure and cardiac rate followed intracranial division of the nerve for relief of pain, subsequent procainization of the homolateral carotid sinus showed the same qualitative effects as occur normally when the sinus is procainized. In 1944 the results of intracranial division of the glossopharyngeal nerve in two patients with hypersensitive carotid sinus reflexes were reported[2] and the present communication is an amplification of that earlier account. These experiences throw additional light on the mechanism of the reflex and indicate a method of treatment which has certain advantages over local denervation of the carotid sinus. With one exception[20] there appears to have been no other experience with division of the glossopharyngeal nerve for correction of the hypersensitive carotid sinus reflex.

While a detailed review of the many contributions to the knowledge of the carotid sinus reflex in experimental animals and in man is unnecessary for this discussion a brief account of certain aspects bears repetition.

The carotid sinus comprises the first portion of the internal carotid artery and perhaps short contiguous portions of the common and external carotid arteries. Specialized nerve endings in the walls of these vessels are sensitive only to stretch or pressure while others respond only to chemical stimulation. Impulses arising from chemical stimulation may be dependent upon the adjacent carotid body[3] whereas impulses resulting from stretch or pressure traverse direct afferent pathways. The afferent nerves of the reflex arc pass centrally to connect with many autonomic efferent pathways. While there are undoubtedly many other afferent mechanisms contributing to autonomic effects, most observers feel that the carotid sinuses and the aortic arch with their associated carotid and aortic bodies exert a major regulatory influence on the central cardiovascular and respiratory control. Stimulation of the sinus by chemical means, by increased pressure from within or by direct pressure from without, causes the heart rate to slow, the blood pressure to fall, and respirations to increase at least until compensated for by other mechanisms.

Normally, constant stimuli from the carotid sinuses exert a tonic inhibitory effect on autonomic centers.[4] When abnormal sensitivity of a sinus reflex exists in man the evidence indicates that the increased afferent impulses result in a variety of symptoms of autonomic overactivity depending on which of the effer-

ent pathways are implicated. In persons more severely afflicted, one of the prominent symptoms is syncope. Through the contributions of Weiss and his associates[5] the syndrome of carotid sinus syncope is well established. The diagnosis is made from the history and from reproduction of the attack by pressure over the abnormal carotid sinus. On the basis of changes in cardiac rate and blood pressure and on the effects of certain drugs on these manifestations during stimulation of the carotid sinus, three types of the syndrome have been described[5]: (1) the "vagal type" in which syncope results from cerebral anoxia due to reflex cardiac asystole, (2) the "depressor type" in which syncope results from cerebral anoxia due to fall in systemic blood pressure alone, and (3) the "cerebral type" in which syncope ensues without significant change in cardiac rate or in blood pressure. The first type is by far the commonest.

Surgical removal of the nerve plexus from the walls of the carotid sinus and from the Y of the common carotid bifurcation has been commonly practiced for relief of hypersensitive carotid sinus. This operation is designed to sever all afferent nerve connections and has a fair degree of success but has sometimes failed apparently because of incomplete removal of all nerves or because of local nerve regeneration.

There are four nerves which contribute to the innervation of the carotid sinus and adjacent carotid body, namely, the glossopharyngeal, vagus, cervical sympathetic, and hypoglossal. The branch to the hypoglossal is inconstant and the part played by this nerve is probably not important. The other three nerves show considerable variation in their gross anatomic arrangements but great constancy in their connections to the carotid sinus and the intercarotid plexus. Embryologically the mesoderm of the third branchial arch artery and the ectoderm of the glossopharyngeal nerve possess an early juxtaposition in the region which is the anlage of the carotid body and carotid sinus; elements from the sympathetic and the vagus enter only at a comparatively late stage of development.[6] From anatomic dissection[7] it has been shown that a distinct and constant branch of the glossopharyngeal nerve connects with the sinus and intercarotid plexus. The importance of this nerve is supported by its striking constancy in all species of animal.[8]

On the basis of animal experimentation Hering[9] believed that the reflex from the carotid sinus was transmitted by a branch of the glossopharyngeal nerve which he named the "sinus nerve" (also known as the nerve of Hering). De Castro[10] on the other hand concluded, as a result of his investigations, that impulses from the carotid sinus reach medullary centers partly through the glossopharyngeal nerve but more particularly by way of the vagus. Kahn[11] believed from his studies on dogs that the main afferent pathway from the carotid sinus is through the glossopharyngeal nerve but on some occasions the vagus takes part. Others[12, 13] have postulated a three-fold afferent supply through the glossopharyngeal, vagus, and sympathetic nerves. Wright[14] believed connections also existed with the hypoglossal nerve. Code and Dingle's investigations[15] designed to settle the discrepancies of previous workers led them to conclude that in dogs the glossopharyngeal connections of the carotid sinus nerve transmit the bulk of the cardiovascular components of the sinus reflex.

Bucy[16] in 1936 raised the question of the possibility that in man interruption of the carotid sinus nerve by intracranial section of the glossopharyngeal nerve could be expected to alter the systemic blood pressure. He cited his experiences with four cases in which the glossopharyngeal nerve was divided intracranially for relief of glossopharyngeal neuralgia and reported a subsequent rise in blood pressure of a few days' duration in each. The conclusions which these observations implied are that in man the major afferent impulses of the sinus reflex are transmitted through the glossopharyngeal nerve.

In a report[1] we made in 1942 it was shown that temporary rises in blood pressure and cardiac rate followed intracranial division of the glossopharyngeal nerve for pain in three cases but no changes occurred in a fourth case. In fifteen additional cases since that time transient rise in blood pressure and cardiac rate have been similarly observed in all but three after intracranial division of the glossopharyngeal nerve. In most of these cases the return of blood pressure and cardiac rate to the preoperative level occurred in one to three days. This is in slight contrast to Bucy's report which showed a return of the blood pressure to normal over a longer period. The resumption of normal blood pressure and cardiac rate is obviously the result of compensation by other regulatory mechanisms, only a part of which is the contralateral carotid sinus reflex.

From additional observations[1] it was shown that postoperatively pressure over the carotid sinus on the side of the nerve section caused no alteration in blood pressure or cardiac rate. However, procainization of the carotid sinus on the side of the nerve section caused a rise in blood pressure similar to that which occurs characteristically with the intact carotid sinus reflex, although the response was quantitatively less than is usually seen. In the cases reported, the procainization tests were made one and five years, respectively, after operation but similar tests have since been made on two other patients two and three weeks, respectively, after intracranial division of the glossopharyngeal nerve and the same effects noted. Therefore, the question of regeneration is eliminated. Also, procaine in an amount equal to that used in blocking the carotid sinus was injected into the trapezius muscle in the latter two patients and no change occurred in the blood pressures or cardiac rates, thus excluding the possible factor of systemic action of the procaine.

These observations indicated, therefore, that in man the afferent impulses of the carotid sinus reflex are not transmitted solely through the glossopharyngeal nerve though the study does not differentiate between other possible pathways for impulses arising from pressure and chemical stimuli. A single observation in another case suggested the vagus nerve as an additional pathway for these impulses. In one patient (Case 13, previously reported)[1] traumatic paralysis of the vagus nerve at the jugular foramen had occurred at the time of intracranial division of the glossopharyngeal nerve. Postoperative procainization of the homolateral carotid sinus did not result in elevation of blood pressure and cardiac rate as had been seen when the test was employed in the presence of an intact vagus nerve after glossopharyngeal nerve section.

An unusual clinical syndrome linking the glossopharyngeal nerve to the carotid sinus reflex has come to attention in the combined glossopharyngeal tic

douloureux and cardiac arrest. The first two cases of this kind were reported briefly in 1942 by Riley and associates[17]; another case (unpublished) of Browder's[18] was observed by one of us (B.S.R.) in 1942, and a fourth case has been reported by us.[19] In this syndrome paroxysms of pain occur in the pharynx and base of the tongue in the region supplied by the glossopharyngeal nerve and simultaneously there is cardiac slowing or arrest, fall in blood pressure, and sometimes syncope. Atropinization of the patient will abolish the cardiac effects, and division of the glossopharyngeal nerve intracranially abolishes the entire syndrome.

With so much evidence pointing to the important role of the glossopharyngeal nerve in the carotid sinus reflex in man, but with insufficient evidence to conclude that this nerve alone comprised the principal afferent pathway in the case of the hypersensitive carotid sinus syndrome, the crucial experiment called for intracranial division of the nerve in a patient with the syndrome. In 1942 Herbert and associates[20] briefly reported their experiences with division of the glossopharyngeal nerve in a 64-year-old man with a hypersensitive carotid sinus. Their observations up to fifteen days postoperative showed the carotid sinus reflex previously induced by pressure over the sinus was abolished on the side of the nerve section.

The following are accounts of three cases in which the glossopharyngeal nerve was divided intracranially on one side for relief of the carotid sinus syndrome.*

CASE REPORTS

CASE 1.—W. R. (Hist. No. 144171), a 71-year-old man, admitted to the New York Hospital in October, 1942, had suffered occasional attacks of syncope for ten years and during the several weeks prior to admission the attacks had increased in frequency from one to four per day. The attacks were characterized by sudden feeling of dizziness, weakness, and confusion. All attacks came while he was walking and although he never fell he often felt that he might were he unable to sit down or hold on to a support. After a few minutes the faintness would pass leaving him with palpitation and a throbbing pain in the top of the head. The whole episode lasted ten to fifteen minutes.

The physical examination disclosed little of significance besides generalized arteriosclerosis. The carotid arteries were sclerotic and moderately enlarged, particularly on the right side in the region of the sinus. The heart was slightly enlarged to the left but otherwise normal. The blood pressure was 124/80 and the form of the electrocardiogram was essentially normal.

Special preoperative tests made with the patient in sitting position were:

1. Pressure over the left carotid sinus caused slowing of the auriculoventricular discharge with blocking of the P wave for four beats then ventricular escape, followed by prompt return to normal sinus rhythm on release of pressure (Fig. 1, *A*). There was a fall in blood pressure, feeling of dizziness, and near syncope.

2. Pressure over the right carotid caused asystole for six seconds followed by ventricular escape, then prompt return to normal rhythm on release of pressure (Fig. 1, *B*). There was a fall in blood pressure and complete syncope.

3. The administration of atropine (0.0006 Gm.) intravenously produced incomplete vagal release. Because of his age the dose was not increased. At the height of the atropine effect, pressure on the left carotid sinus (Fig. 1, *C*) induced very slight slowing of the sinus rate with slight fall in blood pressure. Pressure on the right carotid sinus (Fig. 1, *D*) induced sinus bradycardia with slight fall in blood pressure. Syncope did not occur.

*Two of these cases were reported by Ray and Stewart in 1943.[2]

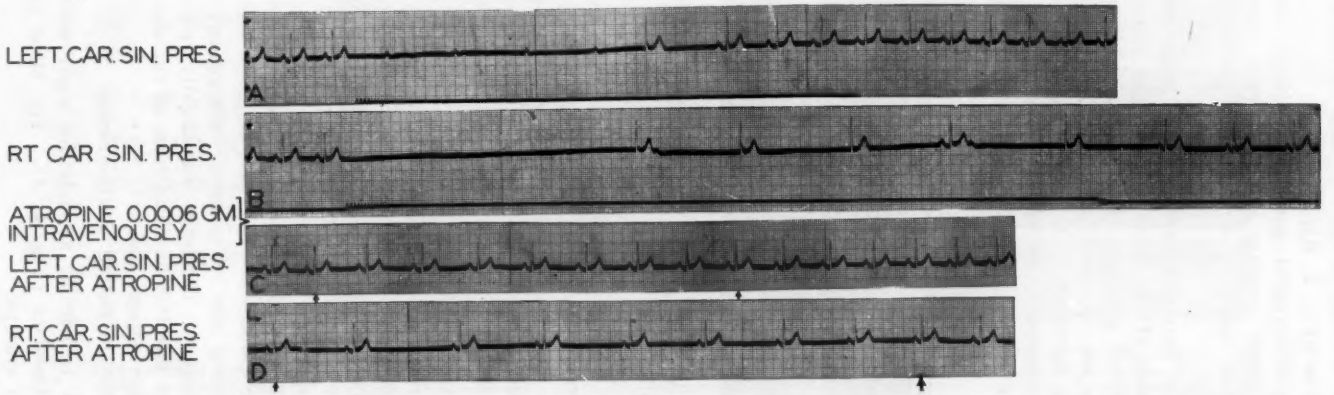

Fig. 1.—In this figure are shown electrocardiograms relating to Case 1 (W.R.). In this figure as well as in those following, the standardization was such that one millivolt produced 1 cm. deflection of the string. Divisions of the ordinates equal 10^{-4} volts. Divisions of the abscissas equal 0.04 second. Lead II is recorded in all instances. In this and the following figures the signal at the bottom of the record indicates when pressure was applied and when released. *A* shows the electrocardiogram taken during pressure over the left carotid sinus. *B* shows Lead II taken during right carotid sinus pressure. *C* shows the effect of left carotid sinus pressure and *D* the effect of right carotid sinus pressure after 0.0006 Gm. atropine intravenously. In *C* and *D* arrows indicate the onset and offset of pressure.

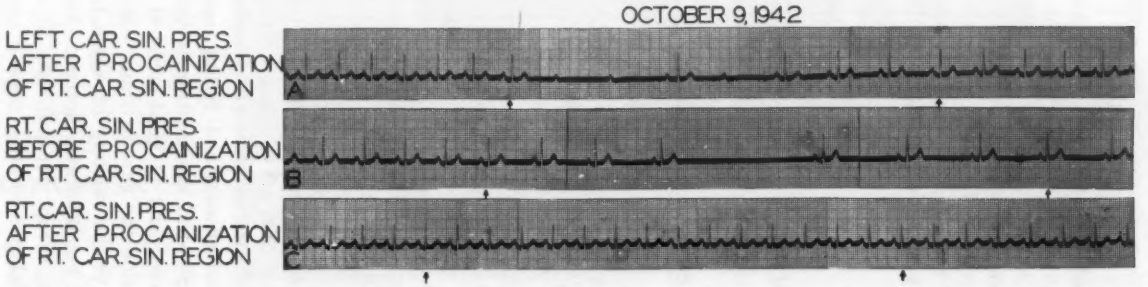
OCTOBER 9, 1942
LEFT CAR. SIN. PRES. AFTER PROCAINIZATION OF RT. CAR. SIN. REGION
A
RT. CAR. SIN. PRES. BEFORE PROCAINIZATION OF RT. CAR. SIN. REGION
B
RT. CAR. SIN. PRES. AFTER PROCAINIZATION OF RT. CAR. SIN. REGION
C

Fig. 2.—In this figure are shown data relating to Case 1. *A* shows the effect of pressure on the left carotid sinus (unanesthetized) after procainization of the right carotid sinus region. *B* shows the electrocardiogram taken during pressure on the right carotid sinus before procainization of this region, and in *C* the electrocardiogram was taken during pressure on the right carotid sinus after its procainization. In this figure arrows indicate the beginning and end of pressure.

4. After procainization of the right carotid sinus region there was slight rise in blood pressure and cardiac rate. Response to pressure on the left (unanesthetized) carotid sinus (Fig. 2, *A*) was the same as on previous occasions. Pressure on the right (anesthetized) sinus did not cause change of any kind (Fig. 2, *C*), whereas pressure applied to this sinus before its procainization showed it to be hypersensitive (Fig. 2, *B*).

At operation (October, 1942) the right glossopharyngeal nerve was divided intracranially. There was only slight transitory rise in blood pressure and increase in cardiac rate following division of the nerve. Recovery from operation was prompt and uncomplicated.

Immediately following operation and during the four and one-half years since operation, pressure over the right carotid sinus (on the side of the nerve section) has failed to cause any alteration in cardiac rate (Fig. 3, *A*), blood pressure, respirations, or state of consciousness. Sensitivity of the left carotid sinus has remained unaltered from its preoperative state (Fig. 3, *B*). In the five years since operation there have been a few mild attacks of faintness which are believed due to the hypersensitivity of the left sinus but the attacks have not been of sufficient degree to require section of the other glossopharyngeal nerve.

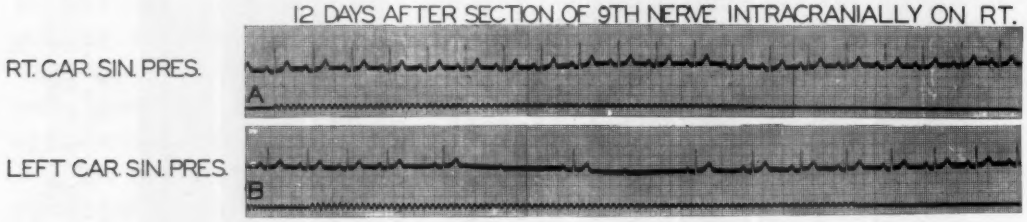

Fig. 3.—In this figure are shown data relating to Case 1. *A* shows the effect of pressure over the right carotid sinus after section of the right ninth nerve intracranially, and *B* the effect of pressure over the left carotid sinus at this time.

Postoperative procainization of the right carotid sinus (on the side of the nerve section) caused a rise in blood pressure of twenty points systolic and five points diastolic without change in cardiac rate. At another time, injection of the deltoid muscle with an equal amount of procaine did not cause any change in blood pressure or cardiac rate, thus eliminating the possibility of any systemic effect of the procaine in producing the changes noted with the former injection.

Case 2.—G. S. (Hist. No. 347441), a 78-year-old man, admitted to the New York Hospital in February, 1944, had for five years experienced syncope whenever a moderate swelling just beneath the angle of the right jaw was deliberately or inadvertently pressed upon. The attacks were characterized by a momentary feeling of swooning followed by loss of consciousness and falling unless he was supported.

The physical examination revealed only generalized arteriosclerosis in a man otherwise well preserved and in good physical condition. The carotid arteries were sclerotic and on the right side the carotid sinus was about twice normal size. The latter enlargement corresponded to the swelling of which the patient was aware. The heart was slightly enlarged to the left but otherwise normal. The blood pressure was 160/90. The form of the electrocardiogram, except for left axis deviation, was within normal limits.

Special preoperative tests made with the patient in sitting position were:

1. Pressure over the left carotid sinus caused ventricular asystole for eight seconds during which there were two or three auricular contractions (Fig. 4, *A*). The blood pressure fell and there was a feeling of dizziness but no syncope.

2. Pressure on the right carotid sinus caused marked sinus bradycardia followed by asystole for four and six-tenths seconds followed by ventricular escape after which, on release of pressure, there were two nodal beats before return to normal (Fig. 4, *B*). The blood pressure fell and complete syncope with a few convulsive twitchings occurred followed by prompt recovery on release of pressure.

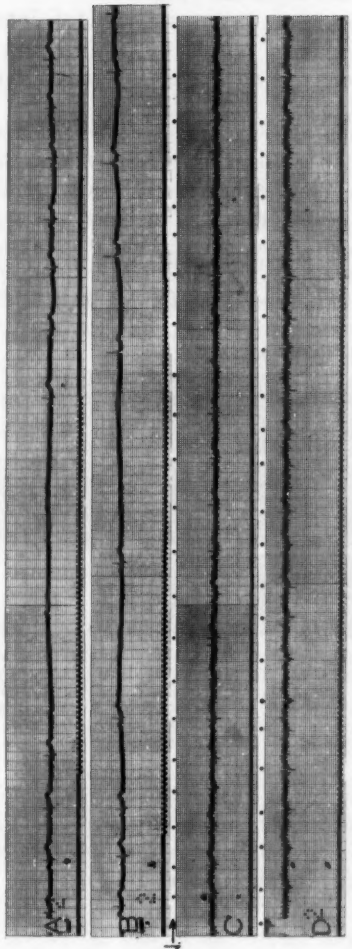

Fig. 4.—**In this figure are shown data relating to** Case 2 (G.S.). *A* shows the effect of pressure over the left carotid sinus, and *B* of pressure over the right carotid sinus. *C* and *D* show the effect of pressure over the right and left carotid sinuses, respectively, after the administration of 0.0009 Gm. atropine intravenously. In *C* and *D* dots identify the QRS complexes as there were muscle tremors with the patient sitting up in bed.

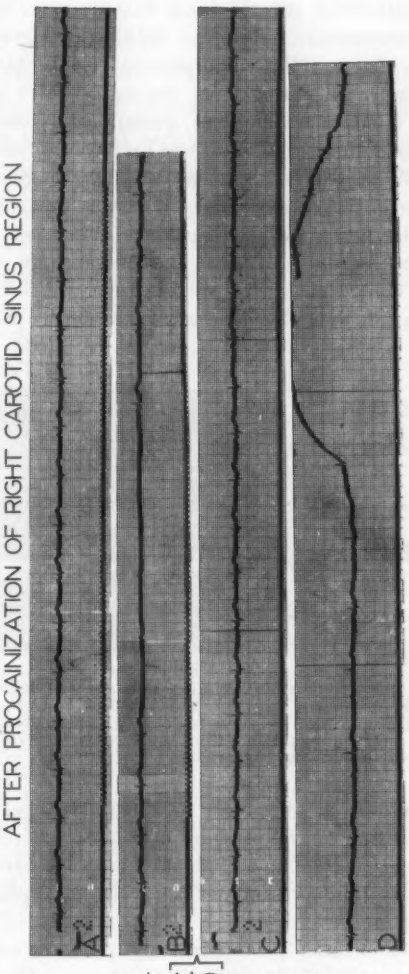
AFTER PROCAINIZATION OF RIGHT CAROTID SINUS REGION
FEB. 3, 1944
RT. CAR. SIN. PRES.
LEFT CAR. SIN. PRES.
SECTION 9TH NERVE ON FEB. 5, 1944 (RT.)
FEB. 25, 1944
RT. CAR. SIN. PRES.
LEFT CAR. SIN. PRES.

Fig. 5.—In this figure are recorded other data relating to Case 2. In *A* and *B* are shown the effects of pressure over the right and over the left carotid sinus, respectively, after procainization of the right carotid sinus region. In *C* and *D* are recorded the effects of pressure on the right and on the left carotid sinuses, respectively, twenty days after section of the right glossopharyngeal nerve intracranially.

3. The administration of atropine (0.0009 Gm.) intravenously abolished all effects of pressure over the right (Fig. 4, *C*) and the left (Fig. 4, *D*) carotid sinuses.

4. After procainization of the right carotid sinus region there was a rise of fifteen points in systolic pressure and slight increase in cardiac rate. Response to pressure on the right anesthetized sinus caused no change of any kind (Fig. 5, *A*), while pressure on the left unanesthetized carotid sinus was the same as on previous occasions (Fig. 5, *B*).

At operation (February, 1944) the right glossopharyngeal nerve was divided intracranially. There followed a prompt rise in blood pressure from 160/90 to 220/120 and a gradual return to normal over the next twelve hours. There was no change in cardiac rate. Recovery from operation was prompt and uncomplicated.

During the three and one-half years since operation the patient has had none of the former attacks of syncope and no longer protects himself against pressure over the enlarged right carotid sinus. Massage and pressure over the right carotid sinus on the side of the nerve section cause no alteration in cardiac rate (Fig. 5, *C*), blood pressure, respirations, or state of consciousness as long as the pressure does not occlude the internal carotid. The responses to pressure over the left carotid sinus, as compared to the preoperative responses, were the same or of less degree when tested on numerous occasions (Fig. 5, *D*).

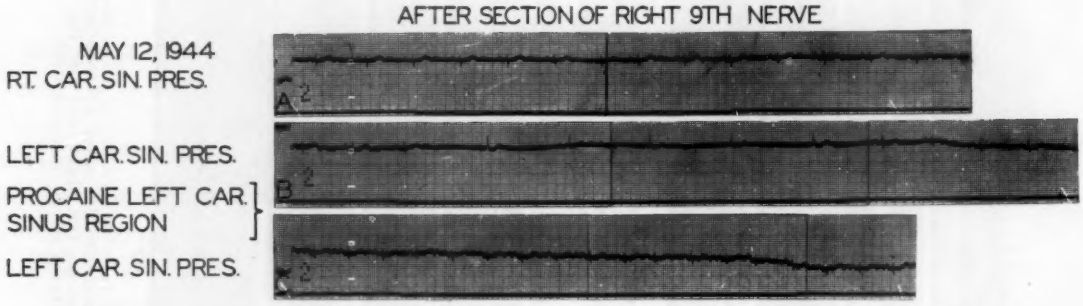

Fig. 6.—In this figure also are shown data relating to Case 2. In *A* is shown the effect of pressure over the right carotid sinus region, and in *B* the effect of pressure over the left carotid sinus region eleven weeks after section of the right glossopharyngeal nerve intracranially. *C* records the effect of pressure over the left carotid sinus after procainization of the left carotid sinus region.

However, in the early postoperative period it was found that with the patient in sitting position heavy pressure over the right carotid sinus, on the side of the nerve section, of sufficient degree to occlude the internal carotid for six to ten seconds sometimes caused a fall in systolic pressure of forty to fifty points without altering cardiac rate or state of consciousness.

Three months postoperatively pressure over the right carotid sinus had no effect on heart rate (Fig. 6, *A*) or on blood pressure. The left carotid sinus possessed the same degree of sensitivity as before operation (Fig. 6, *B*). After a control record was taken (Fig. 6, *B*) anesthetization of the left carotid sinus region (on the side opposite the nerve section) with 24 c.c. of 1 per cent procaine produced a complete Horner's syndrome, marked deviation to the left of the protruded tongue, pronounced hoarseness, and difficulty in swallowing indicating paralysis of the sympathetics, hypoglossal, vagus, and presumably the glossopharyngeal nerves. With the beginning of these effects, blood pressure rose from 170/100 to 236/120 then shortly dropped to 75/50 followed by pallor, sweating, and mental confusion. The electrocardiogram during this period showed no significant change in cardiac rate or rhythm. The head was lowered and after twenty minutes the symptoms of shock passed and the blood pressure rose abruptly to 240/120. The neurologic signs of complete anesthetization of the carotid sinus region were still present and now with the patient in sitting position, massage and pressure insufficient to occlude the artery were applied over the procainized carotid sinus; this did not produce any change in cardiac rate (Fig. 6, *C*), blood pressure, or state of consciousness. However, when heavy pressure was made sufficient to occlude the internal carotid artery for eight seconds, the systolic pressure fell

from 230 to 180, although cardiac rate and state of consciousness remained unaltered. This latter response was comparable to the fall in systolic pressure observed on occlusion of the right internal carotid artery following division of the glossopharyngeal nerve on that side.

Comment.—The postoperative tests demonstrate two things. In some patients following either denervation of the carotid sinus by glossopharyngeal nerve section or procainization of all local nerve connections, compression of the sinus may cause fall in blood pressure, apparently the result wholly of carotid occlusion and unrelated to the carotid sinus reflex. This observation may have a bearing on the "depressor type" of sinus reflex, which may not in all cases be due to the sinus reflex but to anoxia of the brain from carotid occlusion. It would likewise invalidate pressure over the carotid artery as a test of the completeness of carotid sinus denervation in some cases.

The test also demonstrates the inability of bilateral carotid sinus denervation (glossopharyngeal nerve section on one side and procainization of the sinus region on the other) to prevent shock from procaine reaction.

CASE 3.—E. C. (Hist. No. 463127), a 74-year-old man, admitted to the New York hospital in December, 1946, had had about twenty-five attacks of syncope in the previous two and one-half years. The attacks came without warning, usually when standing but occasionally when sitting. After a fleeting sensation of faintness he would fall but always recovered in a matter of seconds and seem none the worse for the experience. During one attack he had hurt his head in a fall and this led to his consulting a physician who made the diagnosis of carotid sinus syndrome by compressing the left carotid sinus and reproducing an attack.

The physical examination revealed only arteriosclerosis compatible with his age. The carotid arteries were not remarkable on palpation. The heart was only slightly enlarged to the left. The blood pressure was 162/92. The electrocardiogram showed only moderate changes in the T waves and RT segments compatible with coronary artery disease. The electroencephalogram was normal.

Special preoperative tests made with the patient in sitting position were:

1. Pressure over the left carotid sinus caused complete auriculoventricular block for eighteen seconds with only one auricular contraction in that time (Fig. 7, *A*). The systolic blood pressure fell from 140 to 86 and the patient became semi-conscious.

2. Pressure over the right carotid sinus caused moderate slowing of the cardiac rate from 79 to 40 per minute (Fig. 7, *B*). The blood pressure fell from 140 to 115 and there was no syncope.

3. The administration of atropine (0.0009 Gm.) intravenously abolished the alteration in cardiac rate following pressure over the right (Fig. 7, *C*) and the left (Fig. 7, *D*) carotid sinus almost entirely but not the fall in blood pressure. Syncope did not occur. A repetition of the tests on the following day showed that the left carotid sinus (Fig. 7, *F*) remained more sensitive than the right (Fig. 7, *E*).

4. On Dec. 10, 1946, pressure over the right (Fig. 8, *A*) and left (Fig. 8, *B*) carotid sinus showed that the left remained more sensitive than the right. After procainization of the left carotid sinus region there was a rise in systolic blood pressure from 115 to 150 and in cardiac rate from 79 to 84. Pressure over the anesthetized left sinus (Fig. 8, *C*) was unaccompanied by any changes, while pressure over the right sinus caused the same changes as noted on previous occasions (Fig. 8, *D*).

At operation (January, 1946) the left glossopharyngeal nerve was cut intracranially. There was a prompt rise of twenty-five points in systolic pressure but none in the diastolic pressure and after two days the systolic pressure resumed its preoperative level. There was no change in cardiac rate. Recovery from operation was uncomplicated.

After operation, on repeated tests the responses to pressure over the right sinus were

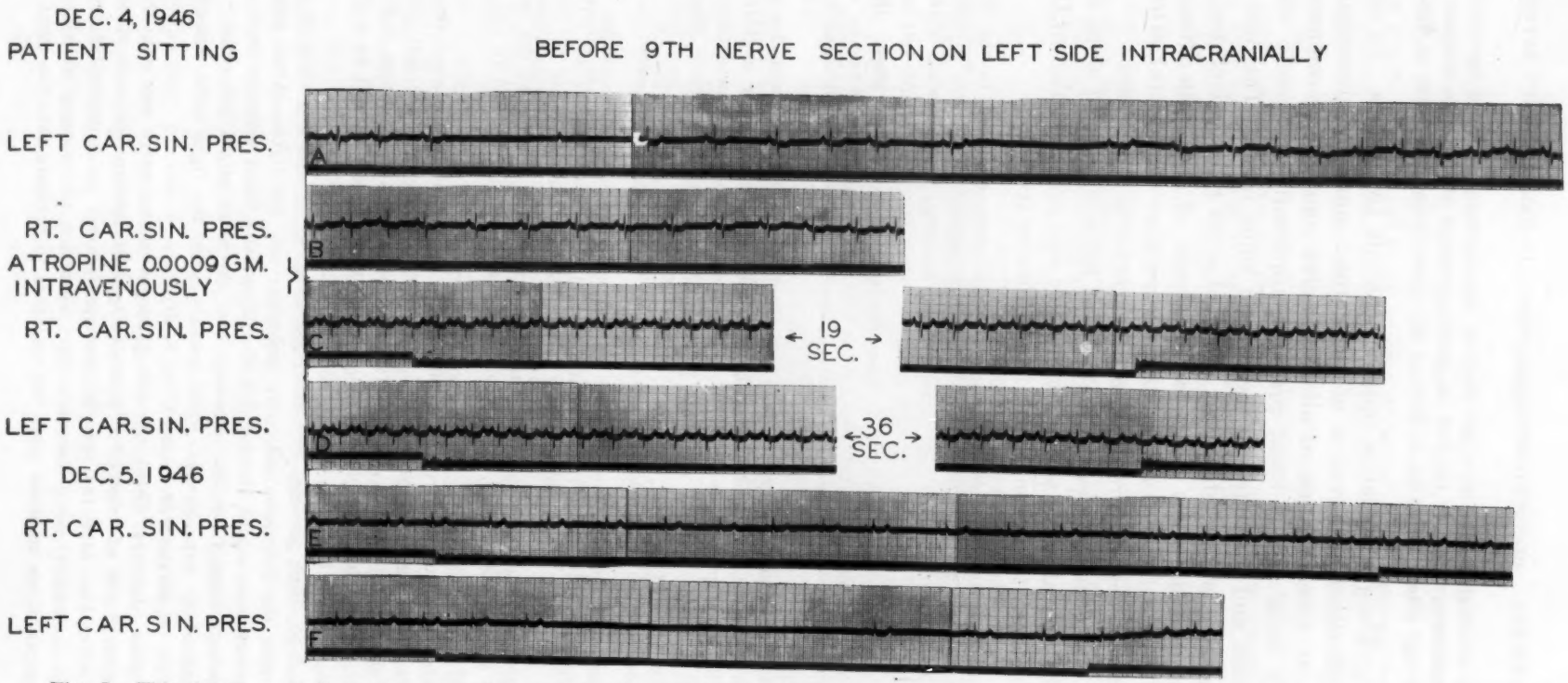

Fig. 7.—This figure as well as Figs. 8 and 9 record data relating to Case 3 (E.C.). *A* shows the effect of pressure over the left carotid sinus, and *B* of pressure over the right carotid sinus. *C* and *D* show electrocardiograms during pressure over the right and over the left carotid sinuses, respectively, after the administration of 0.0009 Gm. atropine intravenously. *E* and *F* show the effect of pressure over the left and over the right carotid sinuses, respectively, on the following day, after the atropine effect had worn off.

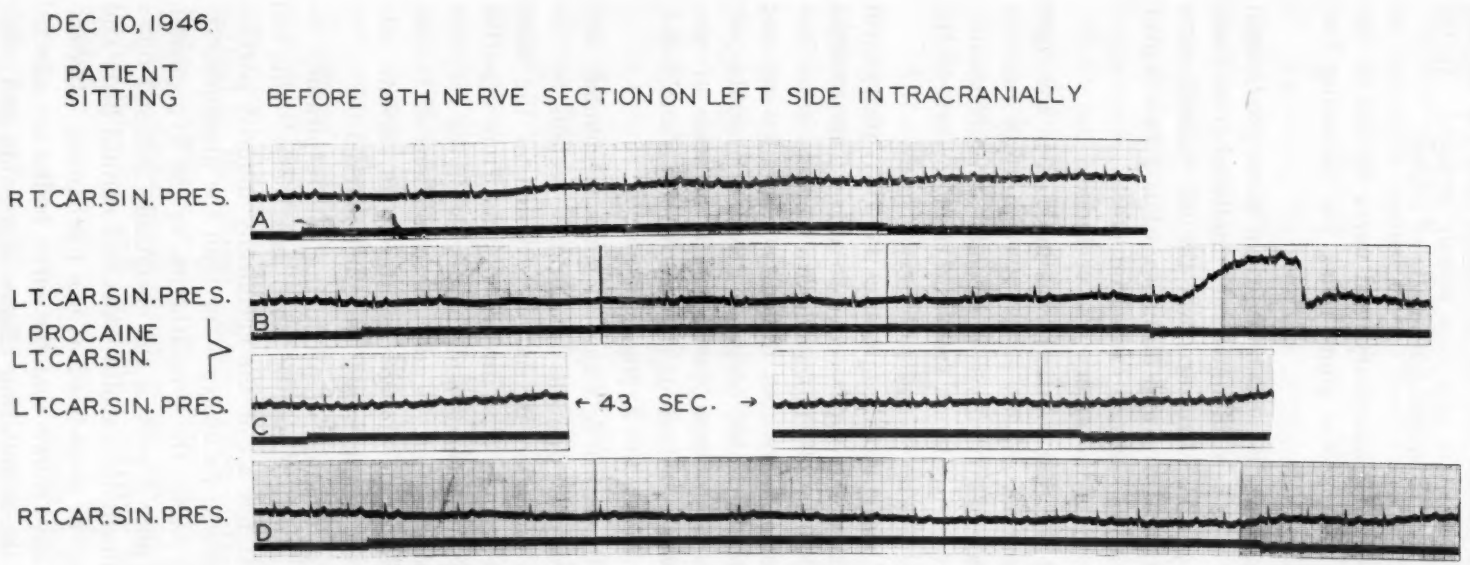

Fig. 8.—In *A* and *B* are shown the effect of pressure over the right and over the left carotid sinus, respectively, on Dec. 10, 1946, in Case 3. *C* and *D* record the effect of pressure over the left and over the right carotid sinuses after procainization of the left carotid sinus.

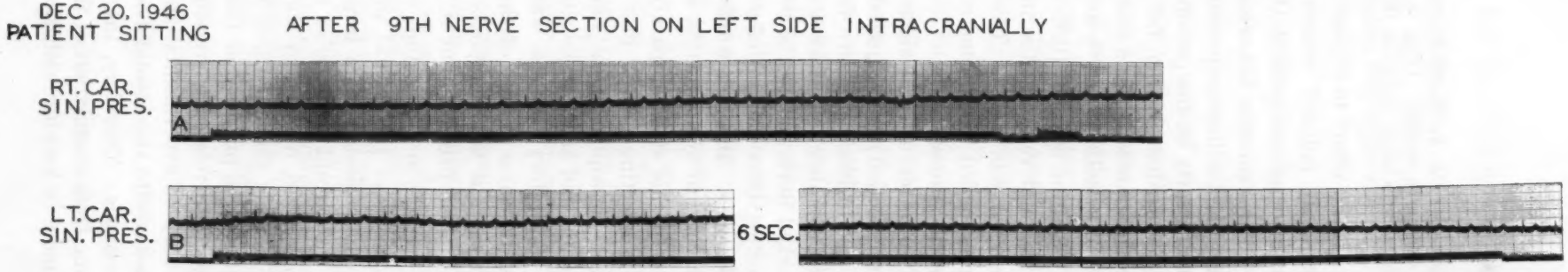

Fig. 9.—In this figure are shown observations made on Dec. 20, 1946, in Case 3 after section of the left glossopharyngeal nerve intracranially. *A* and *B* show the effect of pressure on the right and on the left carotid sinuses, respectively.

unaltered (Fig. 9, *A*) while responses to pressure over the left carotid sinus (on the side of the nerve section) (Fig. 9, *B*) were found to have been entirely abolished. In the eight months since operation there have been no spontaneous attacks of syncope.

In an effort to explore the effect of glossopharyngeal nerve section on the chemically induced component of the carotid sinus reflex the following test was made on one patient (Case 2).

Three months following intracranial division of the right glossopharyngeal nerve the findings on pressure over each carotid sinus were unaltered from those present early in the postoperative period. Pressure over the left carotid sinus caused cardiac slowing, fall in blood pressure, and dizziness, while pressure over the right sinus (on the side of the nerve section) caused no effects except slight fall in systolic pressure sometimes when the artery was occluded.

Sodium cyanide (0.35 c.c. of 2 per cent solution) was injected in the right antecubital vein and the interval until a sudden clear-cut respiratory reaction occurred was timed. This interval was twenty-two seconds and presumably corresponded to the time required for circulation from the right forearm to the carotid sinuses.

The left carotid sinus region (on the side opposite the glossopharyngeal nerve section) was injected with 25 c.c. of 1 per cent procaine. This resulted in rise in blood pressure from 180/90 to 230/120, moderate increase in cardiac rate, complete left Horner's syndrome, hoarseness, difficulty in swallowing, and marked deviation to the left of the protruded tongue. Pressure over the left carotid sinus had no effect on blood pressure, cardiac rate, or state of consciousness. In other words there was paralysis of the left carotid sinus reflex, the cervical sympathetics, and the vagus and hypoglossal nerves.

In this state of paralysis of the entire left carotid sinus mechanism and its connecting nerves, plus paralysis (by previous intracranial section) of the right glossopharyngeal nerve, the injection of sodium cyanide in the same amount and at the same site was repeated. The interval of time from injection to respiratory response was twenty-one seconds and the degree of the response was the same as that of the control injection. Under the conditions of the experiment it was not possible to determine changes accurately in cardiac rate and blood pressure, but if there were changes they were not marked.

If the site of action of sodium cyanide in producing the respiratory response is at the carotid sinus, as is maintained by Robb and Weiss,[21] this test would indicate that a large part if not all of the chemically induced portion of the carotid sinus reflex must traverse pathways other than the glossopharyngeal nerves, namely, by way of the vagus, the sympathetics, or the hypoglossal. It is likely that the carotid bodies play a part in the chemically induced reflex but for the purposes of this experiment the carotid sinus and carotid body and their interrelated nerve supply may be considered as one mechanism. Investigations on experimental animals[22] have shown that the aortic bodies are affected similarly to the carotid bodies by the stimulating effects of cyanide and other chemicals. Therefore, the respiratory response in this case could theoretically come from stimulation of the aortic bodies but the time interval of the response is more in keeping with stimulation of the carotid sinus. The matter might be

settled if the same test were repeated after additional blocking of the right vagus nerve below the carotid sinus, but the bilateral vagus nerve block would be hazardous because of the resulting bilateral laryngeal nerve paralysis.

DISCUSSION

Following the stimulus of the work of Weiss and his co-workers[5] on the clinical aspects of the normal and abnormal carotid sinus reflex in man, surgical resection of the intercarotid plexus and stripping of the carotid bulb were rather widely employed in patients with hypersensitive carotid sinus reflex. Initial enthusiasm over the operation has become leavened somewhat by its failure to relieve syncope and convulsions in all cases in which it was employed. Nerves are believed to regenerate sometimes and occasional accidents to the carotid artery are known to have occurred. Obviously some cases have been poorly selected for operation and in our experience a relatively small number of patients presumed to have an abnormally sensitive carotid sinus reflex requires surgical intervention.

Although extensive investigations have been made on experimental animals of the contributions of the various nerves in the afferent arc of the carotid sinus-carotid body reflex, the experiences could not be reliably correlated to the human being. Considerable indirect evidence existed to indicate that the glossopharyngeal nerve and its branch, the "carotid sinus nerve," played a major role in this reflex although anatomic connections to the sinus of two other cranial nerves and the sympathetics have been reliably demonstrated.[7, 23] The intracranial division of the glossopharyngeal nerve in patients with the carotid sinus syndrome has positively shown that all the effects resulting from pressure on the sinus are transmitted by this nerve. Additional evidence indicates that probably the chemically induced component of the reflex is transmitted principally by nerves other than the glossopharyngeal. Since the carotid sinus syndrome appears to be largely if not wholly due to pressure stimuli, selective division of the glossopharyngeal nerve is ideally suited to those patients requiring surgery.

Because of the fact that the carotid sinus nerve joins the glossopharyngeal nerve near the base of the skull, and sometimes within the jugular foramen,[7] division of the nerve through a cervical incision is not practical. As a neurosurgical procedure, intracranial division of the glossopharyngeal nerve is relatively simple and safe and the resulting anesthesia in the glossopharynx is unnoticed by the patient. Regeneration of the nerve is impossible and an additional advantage is that the hypersensitive reflex can be interrupted in those cases of carotid body tumor, other cervical neoplasms, aneurysms, tuberculous nodes, infection, and irradiation scarring where local dissection may be precluded.

CONCLUSIONS

1. The glossopharyngeal nerve transmits the afferent impulses of the carotid sinus reflex induced by pressure on the carotid sinus.

2. Intracranial division of the glossopharyngeal nerve permanently abolishes the effects of pressure on the homolateral carotid sinus.

3. The chemically induced part of the carotid sinus reflex probably remains intact after intracranial division of the glossopharyngeal nerve.

4. As an alternative procedure to local denervation of the carotid sinus for relief of the carotid sinus syndrome, intracranial glossopharyngeal nerve section has an advantage in that the former procedure may be followed by regeneration of the nerves and possesses the hazard of damage to the carotid artery.

5. Intracranial division of the glossopharyngeal nerve can be employed in patients in whom the condition of the local tissues about the carotid sinus might make local surgery undesirable or impossible.

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END RESULTS IN THE TREATMENT OF PEPTIC ULCER BY POSTERIOR GASTROENTEROSTOMY

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INTRODUCTION

IN THE forty-eight years since Doyen first performed posterior gastroenterostomy for peptic ulcer, this operation has been performed on many thousands of patients. After a period of development, the procedure came to be used with enthusiasm, and, in this country, during the period from 1910 to 1930, it was the surgical method most commonly employed for treating peptic ulcer. For a brief period the pyloroplasty (either Judd or Finney) was used in certain clinics, but it was never a serious competitor of gastroenterostomy. Up to 1930 most surgeons in this country reserved gastric resection for gastric lesions, either ulcer or cancer, although Billroth, von Haberer, and Finsterer on the continent, and Berg and Lewisohn in this country had advocated gastric resection for duodenal ulcers, particularly those in the active stage of bleeding. As the failures of gastroenterostomy became more numerous, and chronic marginal ulcers and their complications accumulated in the large clinics of this country, there was a gradual shift toward gastric resection. This change, and the conviction that gastric resection gave better results, became general during the period from 1930 to 1940. With experience, improved techniques, better pre- and postoperative care, and chemotherapy, surgeons learned to perform gastric resection with a reasonable mortality. In most clinics today gastroenterostomy is in disrepute, and has been replaced largely by the more radical procedure. The younger group of surgeons, particularly, have come to feel that gastroenterostomy is a faulty operation, and that anything short of a resection will yield a poor result. Among the more seasoned groups of surgeons are still to be found those who champion gastroenterostomy, and use it frequently. Between these two groups there is considerable controversy over the relative merits of the two procedures.

Today, the end results of a new surgical treatment for peptic ulcer, vagotomy, are being projected into this old controversy. Unless vagotomy clearly proves to be the panacea that all those interested in this field have long looked for, there is reason to believe that the evaluation of gastric operations will be further beclouded. This is particularly true if vagotomy is to be used simultaneously with gastroenterostomy or resection. It is timely, therefore, that we review our past experience and try to evaluate objectively and accurately the long-term end results of gastric operations. The purpose of this paper is not to compare the results of gastroenterostomy and gastric resection, but to give as complete and clear a picture as possible of what one can expect from the older procedure, gastroenterostomy. It is hoped that a review of our experience may give insight and perspective to those performing gastric surgery.

CLINICAL MATERIAL

In the thirteen and one-quarter year period between Oct. 1, 1932 and Dec. 31, 1945, there were 279 posterior gastroenterostomies done for peptic ulcer on the ward services of the New York Hospital. The distribution of these cases over the years is shown in Table I, which lists the number of operations done each year (Column 1), the operative deaths (Column 2), the operative survivors (Column 3), and the cumulative operative survivors (Column 4). Perusal of Column 1 shows that fewer posterior gastroenterostomies were done after 1940. This occurred in spite of a growing volume of gastric cases, for, in keeping with the popular trend, gastric resections were performed more frequently than gastroenterostomies.

METHOD OF REPORTING

The method used for reporting the end results is that which I devised in 1947.* The cases are grouped by follow-up year, irrespective of year of operation, and the poor results occurring in each follow-up year are determined. This enables us to use all of the material and to express end results in the form of a graph. Since a detailed description of this method is available in the reference, only the essentials necessary for following the text will be given in this paper. Briefly, the method is as follows:

1. The clinical material is charted first in Table I, described previously, from which we obtain figures on operative mortality and cumulative operative survivors at the end of each calendar year (Column 4).

2. The figures on cumulative operative survivors are corrected for deaths that occurred during the follow-up period by subtracting the deaths in those cases up to the follow-up year in question. This is shown in Table II, which lists the cumulative operative survivors (from Table I, Column 4), the deaths occurring in those patients up to the respective year of follow-up (Column 2),

TABLE I. LIST OF POSTERIOR GASTROENTEROSTOMIES BY CALENDAR YEAR SHOWING OPERATIVE DEATHS AND SURVIVORS

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4
YEAR OF OPERATION	NUMBER OF OPERATIONS	OPERATIVE DEATHS	OPERATIVE SURVIVORS	CUMULATIVE OPERATIVE SURVIVORS
1932	3	0	3	3
1933	22	2	20	23
1934	35	0	35	58
1935	24	3	21	79
1936	26	2	24	103
1937	25	0	25	128
1938	25	1	24	152
1939	19	0	19	171
1940	16	0	16	187
1941	11	0	11	198
1942	16	1	15	213
1943	32	0	32	245
1944	14	0	14	259
1945	11	0	11	270
Totals	279	9 (3.2%)	270	270 (96.8%)

*Cooper, William A.: A Method of Statistical Analysis, SURGERY 22: 367-379, 1947.

TABLE II. CORRECTION FOR DEATHS DURING FOLLOW-UP PERIOD AND CASES ACTUALLY FOLLOWED

		COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4
OPERATIVE YEAR	FOLLOW-UP YEAR	CUMULATIVE OPERATIVE SURVIVORS	DEATHS OCCURRING BEFORE F-U YEAR	CUMULATIVE NET SURVIVORS	CASES FOLLOWED EACH FOLLOW-UP YEAR
1932	14	3	1	2	2
1933	13	23	4	19	8
1934	12	58	10	48	31
1935	11	79	14	65	50
1936	10	103	16	87	67
1937	9	128	19	109	81
1938	8	152	21	131	102
1939	7	171	21	150	124
1940	6	187	19	168	143
1941	5	198	18	180	157
1942	4	213	15	198	177
1943	3	245	14	231	208
1944	2	259	8	251	237
1945	1	270	5	265	257
1946	0				

and the cumulative net survivors (Column 1 minus Column 2). *Cumulative Net Survivors* refers to the number of cases possible to follow each year after operation. The number of cases actually followed each follow-up year, irrespective of year of operation, is then obtained and recorded (Column 4). The ratio between *cumulative net survivors* and *cases actually followed* each follow-up year is converted to per cent and recorded as the follow-up curve (see Fig. 1).

3. The poor results or failures of gastroenterostomy are then determined, each failure being recorded in the follow-up year in which the case first became classified as a poor result (Table III, Column 2). In Table III, Column 1 the cases actually followed are listed (from Table II, Column 4), and the ratio of poor results to cases actually followed each follow-up year is recorded as percentage (Column 3). These percentages are accumulated (Column 4), and

TABLE III. POOR RESULTS IN FOLLOW-UP YEARS

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4
FOLLOW-UP YEAR	CASES FOLLOWED EACH FOLLOW-UP YEAR	POOR RESULTS	PERCENTAGE OF POOR RESULTS (COL. 2/COL. 1)	ACCUMULATED PERCENTAGE OF POOR RESULTS
14	2	0	0	25.21
13	8	0	0	25.21
12	31	1	3.2	25.21
11	50	0	0	22.01
10	67	0	0	22.01
9	81	0	0	22.01
8	102	0	0	22.01
7	124	1	0.81	22.01
6	143	0	0	21.20
5	157	4	2.54	21.20
4	177	7	3.96	18.66
3	208	4	1.92	14.70
2	237	10	4.22	12.78
1	257	22	8.56	8.56
0				

are then charted on Fig. 2, *A*, which is the failure curve. The percentage of failures or poor results is thus measured at the level of each follow-up year.

FOLLOW-UP

It is important to know what portion of the cases in the series were followed. This information is charted in Fig. 1, which shows the ratio of cases actually followed to cases that could have been followed for each year after operation.

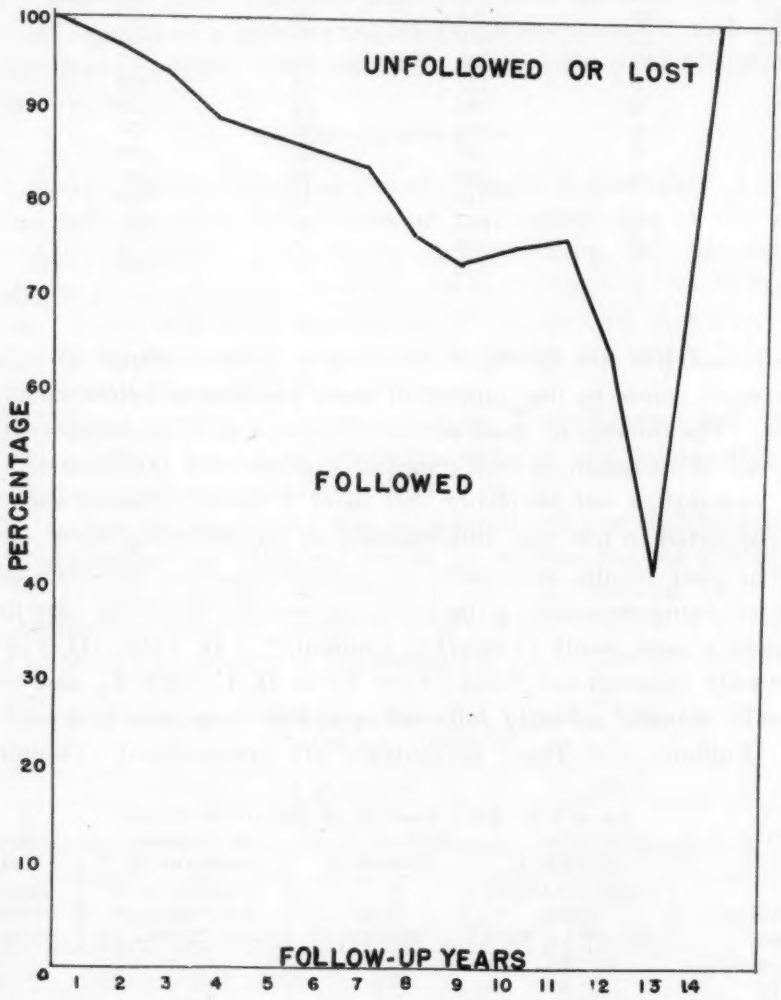

Fig. 1.—Follow-up curve. (From Cooper, SURGERY, August, 1947.)

The percentage above the line is lost, and that below the line is followed. It will be noted that the follow-up decreases from 97 per cent the first year to a low of 42 per cent in the thirteenth year. In the fourteenth year it goes up to 100 per cent, for follow-ups happened to have been carried out on the two patients who were operated upon and survived the fourteen-year period.

It is felt that a follow-up graph, or similar information, is important in any follow-up study, for it tells the reader how much of the total picture the

author has been able to observe and report upon. This is particularly true if the author or the reader is to compare two groups of cases. Unless the completeness of the follow-up is similar in two groups of cases, they must be compared with caution.

ANALYSIS OF CASES

The cumulative operative survivors (Table I, Column 4) are divided into good and poor results. For the purpose of this study a poor result is defined as any patient who, at any time after gastroenterostomy, (1) must be rehospitalized for peptic ulcer either in this or any other hospital, or (2) has any evidence, either by history or examination, of bleeding from the upper gastrointestinal tract, or (3) has either clinical or x-ray evidence of a marginal ulcer. This includes all patients having many gastric complaints after gastroenterostomy. It does not include a number of patients with pain, gas, belching, or indigestion, all of a mild or transient nature. These cases are considered satisfactory results. The ratio between good and poor results at the level of each follow-up year is shown in Fig. 2, *A*, the *failure curve*. The figures for the failure curve are listed in Table III.

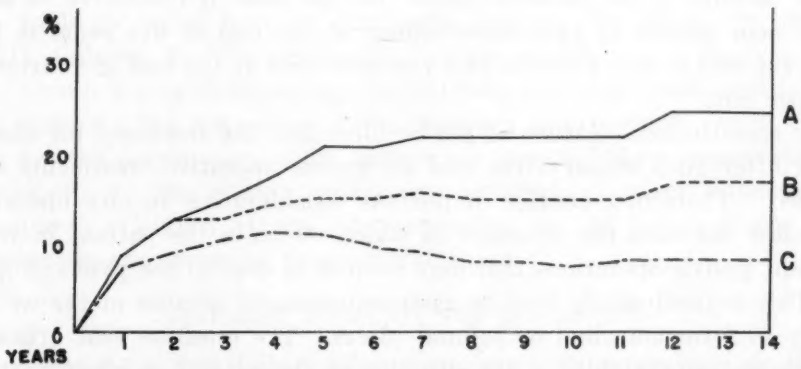

Fig. 2.—Failure curves. *A*, Failure curve; *B*, failure curve after conservative treatment; *C*, failure curve after conservative and operative treatment.

The criteria of a poor result in this study are quite rigid, for any patient having had any notable recurrence *at any time* after operation is considered as having a poor result and charted as such on the failure curve. By the fourteenth year 49 cases are recorded as poor results (Table III, column 2) on the failure curve, each case being represented by the percentage of those followed each follow-up year, irrespective of operative year. It will be noted that 47 of the 49 failures occurred by the fifth year after operation. This strongly supports the view that if a gastroenterostomy does well for five years after operation the chances of continuing to do so are excellent.

A number of the 49 poor results are now classified as good results. Thirteen cases satisfied the criteria of failure, yet subsequently the patients became well, and remain well at the time of this study, without further operative treatment. For these patients gastroenterostomy, considered from the perspective of a

good many years of follow-up, has been a highly successful operation. Yet at one time during the postoperative course (within five years of operation) they were considered as having poor results. If this study confined itself to five-year end results, many of these would have to remain poor results. The obvious question that arises is how they should be catalogued now. One can take the view that these cases should not be reported as failures of gastroenterostomy, yet all will have to concede that whether these cases are reported as good or poor depends upon the year in which the end result study is made. In view of this, I am of the opinion that the truest picture is presented by considering these cases as "once a failure, always a failure" on the primary failure curve, and correcting this pessimistic picture by a second or modified failure curve, on which the poor results that subsequently became good results under conservative treatment are subtracted. This *modified failure curve* gives a true and clear picture of the end results of gastroenterostomy over a period of years. The values on this modified curve, rather than those on the primary curve, are the ones that reflect the long-term end results of the operation.

The failure curve, modified by subtracting the cases that become good without further surgery, is given in Fig. 2, *B*. It will be noted that this curve is flatter than the primary failure curve, and that it is actually reduced slightly from the seventh to the eleventh years. On the basis of this curve we can state that the poor results of gastroenterostomy at the end of five years is 16.3 per cent, at the end of ten years is 16.0 per cent, and at the end of fourteen years is 18.5 per cent.

The constitutional nature of peptic ulcer and the tendency for ulcerations to recur after both conservative and all known operative treatments are well recognized. Therefore, another important consideration in any operation for peptic ulcer concerns the situation in which we leave the patient in regard to subsequent gastric operations that may have to be done if the primary operation fails. This is particularly true in gastroenterostomy because of the well-known tendency to form marginal or jejunal ulcers. The question that arises is how favorable (or unfavorable) is the situation of the patient in whom gastroenterostomy fails. Is his position hopeless or can he be salvaged and put in a condition to enjoy a normal life free of gastric symptoms?

To answer this question the failures of gastroenterostomy after further operative treatment (26 cases) are analyzed. The failure curve modified by both conservative and further operative treatment is given in Fig. 2, *C*. It will be noted that with the benefit of further operative treatment on the patients in whom gastroenterostomy has failed, the net failures are reduced to 8.2 per cent.

METHOD OF MODIFYING THE FAILURE CURVE

To modify the failure curve by cases that subsequently become good results we must calculate the percentage for the modified curve for each follow-up year by the formula:

> Cumulative failures : modified cumulative failures :: failure curve percentage : modified failure curve percentage.

TABLE IV. FIGURES FOR MODIFYING THE FAILURE CURVE

FOLLOW-UP YEAR	COLUMN 1 CUMULATIVE FAILURES	COLUMN 2 CUMULATIVE FAILURES MODIFIED BY CONSERV-ATIVE TREATMENT	COLUMN 3 PERCENTAGE ON PRIMARY FAILURE CURVE	COLUMN 4 PERCENTAGE ON FAILURE CURVE MODIFIED BY CONSERV-ATIVE TREATMENT	COLUMN 5 CUMULATIVE FAILURES MODIFIED BY CONSERV-ATIVE AND OPERATIVE TREATMENT	COLUMN 6 PERCENTAGE ON FAILURE CURVE MODIFIED BY CONSERV-ATIVE AND OPERATIVE TREATMENT
0						
1	22	22	8.56	8.56	20	7.79
2	32	30	12.78	12.80	24	9.57
3	36	30	14.70	12.24	24	9.80
4	43	35	18.66	15.19	27	11.70
5	47	36	21.20	16.27	24	10.82
6	47	36	21.20	16.27	22	9.94
7	48	36	22.01	16.50	21	9.63
8	48	35	22.01	16.05	18	8.26
9	48	35	22.01	16.05	18	8.26
10	48	35	22.01	16.05	17	7.79
11	48	35	22.01	16.05	17	7.79
12	49	36	25.21	18.54	16	8.24
13	49	36	25.21	18.54	16	8.24
14	49	36	25.21	18.54	16	8.24

The figures for the modified failure curves, *B* and *C*, are given by follow-up year in Table IV which lists the cumulative failures (by adding the cases from Table III, Column 2), the cumulative failures modified by conservative treatment (Column 2—by subtracting the patients who had good results without further surgery), the percentage on the primary failure curve (from Table III, Column 4), the percentage on the failure curve modified by conservative treatment (Column 4), the cumulative failures modified by conservative and operative treatment (Column 5), and the percentage on the failure curve modified by conservative and operative treatment (Column 6).

OPERATIVE MORTALITY AND END RESULTS

In a sense, the first failure of any operative procedure is a death due to operation. In considering which gastric operation to do on a given patient, the surgeon must estimate the chance of survival and the possibility of a satis-

TABLE V: ANALYSIS OF OPERATIVE DEATHS

CASE	AGE (YR.)	OPERATIVE YEAR	POST-OPERATIVE DAY OF DEATH	CAUSE OF DEATH
1. W. M.	67	1933	1st	Massive pulmonary embolus from deep veins of leg
2. N. R.	72	1933	19th	Evisceration and multiple small ulcers in gastric mucosa
3. C. F.	58	1935	4th	Peritonitis
4. E. H.	64	1935	22nd	Massive pulmonary embolus from deep veins of leg
5. M. M.	29	1935	37th	Peritonitis
6. F. M.	76	1936	7th	Bronchopneumonia
7. A. L.	69	1936	3rd	Bronchopneumonia
8. J. C.	51	1938	5th	Bronchopneumonia and cirrhosis of liver
9. C. M.	69	1942	15th	Cerebral thrombosis

factory end result. Therefore, operative mortality must be considered in any gastric operation. Operative mortality is brought into the end result picture in Fig. 3, where the various failures are charted on top of the operative mortality. Thus, we see that the failure of gastroenterostomy at the end of the follow-up period, taking operative mortality into consideration, is 28.4 per cent, that with the benefit of conservative treatment it is 21.7 per cent, and that with the benefit of further operative treatment it is 11.4 per cent. Fig. 3 brings together all of the information related to end results in the entire group of 279 gastroenterostomies done at the New York Hospital.

During the thirteen and one-quarter year period, 279 gastroenterostomies were performed with nine operative deaths, an operative mortality of 3.2 per cent. Details of the operative deaths are outlined in Table V.

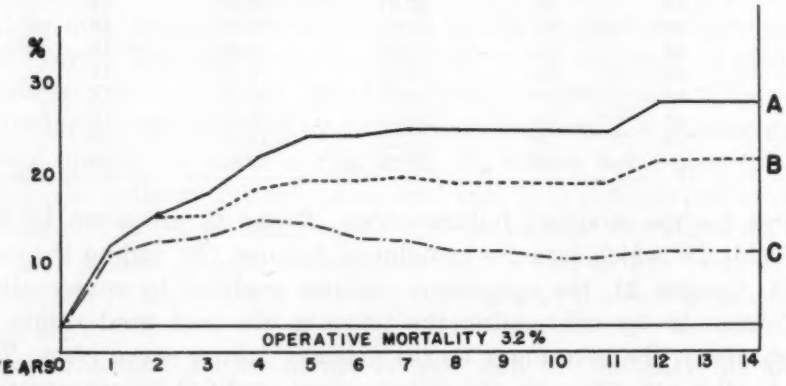

Fig. 3.—Failure curves superimposed on operative mortality. *A*, Failure curve; *B*, failure curve after conservative treatment; *C*, failure curve after conservative and operative treatment.

It will be noted that the operative deaths are fairly evenly divided into three groups: those caused by vascular accidents (Cases 1, 4, and 9); those caused by pulmonary complications (cases 6, 7, and 8); and those caused by peritonitis (Cases 3 and 5). One patient (Case 2) died of evisceration and multiple gastric erosions. With the advances in chemotherapy today it seems likely that the pulmonary and peritonitis deaths (about half of the nine deaths) could be avoided. Perusal of the operative deaths listed in Table I, Column 2 shows that there were but 2 deaths in the last 169 operations done. This evidence supports the view that gastroenterostomy can be done today with an operative mortality of not more than 2 per cent.

ANALYSIS OF POOR RESULTS

Pathology.—There were 49 patients who had unsatisfactory results at some time during the follow-up period after gastroenterostomy. The pathology in those with recurrent symptoms is listed in Table VI.

Many of the patients who eventually proved to have marginal or jejunal ulcer had x-ray findings at one time or another during the course which suggested reactivation of the original duodenal ulcer. Yet in all patients in whom the pathology was proved, except the last three listed, reoperation or repeated

TABLE VI

PATHOLOGY	NUMBER OF CASES
Marginal or jejunal ulcer	37
(2 also had gastrojejuno colic fistula, 1 also had a new gastric ulcer)	
Suspected but not proved marginal ulcer	9
Gastric ulcer (primary ulcer duodenal)	1
Gastric ulcer which persisted	1
Duodenal ulcer which persisted	1
Total	49

x-rays have proved them to have a marginal or jejunal lesion. One patient with primary duodenal ulcer had a gastric ulcer that accounted for the recurrent symptoms; one patient with primary gastric ulcer had a fatal hemorrhage three weeks after gastroenterostomy; in only 1 case in the 49 failures did the patient prove at operation to have a persistent duodenal ulcer after gastroenterostomy. Three months after the primary operation this patient had a bleeding episode for which a pylorectomy was done. The duodenal ulcer was removed, but the stoma failed to function, and was resected three weeks later. No marginal lesion was found. This patient developed a marginal ulcer at the site of the new stoma, which later perforated and was the cause of death. This patient continued to have poor results after two operative procedures since the unsuccessful gastroenterostomy. In no other case in this entire series was the pathology proved to be reactivation or persistence of the duodenal ulcer. In every other case in which the pathology was established by reoperation, the original duodenal ulcer was healed.

Clinical Symptoms.—In the 49 poor results the outstanding clinical manifestations of failure were as shown in Table VII.

TABLE VII

MANIFESTATION	NUMBER OF CASES	PER CENT
Pain only	21	42.8
Hemorrhage only	12	24.6
Pain and hemorrhage	16	32.6
Total	49	100.0

The most common recurrent symptom was pain (75.5 per cent), which was usually intermittent, boring, and relieved by food and alkalies. In most cases the pain was similar to that caused by the original ulcer except for its location. The pain in marginal ulcer is usually a bit lower and to the left of the duodenal ulcer pain, and a patient who has experienced both can often distinguish them. In only two of the patients having recurrent pain as their only symptom was marginal ulcer not proved.

Gastrointestinal hemorrhage followed pain in frequency (57.1 per cent). There were between one and five bleeding episodes after operation, and the clinical manifestations of bleeding varied from a few tarry stools to vomiting of unchanged blood with fatal shock, depending upon the severity of the hemorrhage. In 4 of the 26 patients who bled the hemorrhage was fatal, and in 8 it could be considered mild. Of the 12 who had bleeding as their only recurrent symptom, marginal ulcer was proved in 6, and suspected but not proved in 6.

This brief analysis suggests that when pain becomes a prominent clinical feature after gastroenterostomy, a diagnosis of marginal ulcer is most likely. The most significant physical finding is point tenderness localized in the region of the stoma or the marginal lesion. It is believed that point tenderness, when present, is highly significant in establishing the diagnosis. Nausea and vomiting were often present, but were inconstant, and are not considered of particular diagnostic importance.

Correlation of Symptoms Before and After Gastroenterostomy.—Practically all of the patients had some pain before operation, yet there were 12 who had hemorrhage without pain as the recurrent symptom of failure. There were 19 who had hemorrhage before gastroenterostomy, and 28 who bled after operation. Twelve of these patients had hemorrhage both before and after operation. Seven bled before operation, but not afterward, while 16 bled afterward, and not before. Pain is a more constant finding in the primary ulcers, and hemorrhage a more common occurrence in marginal ulcers, yet there is considerable overlapping of all pre- and postoperative symptoms. There is no particular correlation between primary and recurrent symptoms, nor would one expect there to be such a correlation if the new symptoms are due to a new (marginal) ulcer.

The Diagnostic Value of Roentgenology and Gastroscopy.—It is difficult to evaluate the accuracy of x-ray and fluoroscopic examinations in diagnosing marginal ulcer. The impression exists among clinicians that the method often fails to visualize the marginal or jejunal lesion, yet the clinician too is often mistaken in assuming its presence. This is particularly true of the patients with painless hemorrhage, who may have a negative examination after recovering from the bleeding episode, and who, indeed, may be found to have a normal stoma and a healed duodenal ulcer on exploration. In patients who bleed without pain, and in whom the pain is not persistent, treatment may have healed the superficial lesion before the x-ray studies were done. In this series, particularly those studied in recent years, we have found the roentgenologist quite accurate in diagnosing marginal or jejunal lesions. Although he is not always successful in demonstrating an ulcer crater, accompanying jejunitis or spasm often adds sufficient confirmatory evidence to make the diagnosis reasonably certain. The roentgenologist is not accurate in estimating the activity of the old duodenal lesions. It has been repeatedly borne out in this series that, though he demonstrated a crater in the duodenum, the crater may be healed.

Gastroscopy has not been particularly helpful in diagnosing marginal lesions. The stoma is often partially obscured by the reflux of the jejunal contents, and the overhanging margins and jejunum cannot be clearly visualized. If the stoma does appear normal from the stomach side, an ulcer on the jejunal side cannot be ruled out. Occasionally, however, a marginal lesion will be clearly seen, and visualization may clarify the clinical problem.

Factors Influencing End Results.—Since some patients do very well after gastroenterostomy, and others do equally poorly, there has been a continuous effort to discover the factors that influence this varied response. Some of the factors that have been thought to be pertinent are type of personality, age,

nationality, occupation, clinical type of ulcer, and location of ulcer. Though something is known of the psyche in most of the patients in this series, the information is too superficial and spotty to be of value. It is not within the scope of this study to analyze all of the forces that may have influenced end results; age, nationality, clinical type, and location will be considered.

Results in age groups: In the days before gastroenterostomy was relegated to the category of discarded or obsolete operations, one often heard it said that the older rather than the younger age groups did better with the operation. The age distribution of the 270 operative survivors and the 49 failures of gastroenterostomy are shown in Table VIII.

TABLE VIII. AGE DISTRIBUTION OF ENTIRE SERIES AND POOR RESULTS

AGE (YR.)	ENTIRE SERIES	POOR RESULTS	PERCENTAGE OF POOR RESULTS
20-29	9	1	11.1
30-39	78	20	25.6
40-49	98	14	14.3
50-59	56	11	19.6
60-69	22	1	4.5
70-79	7	2	28.6
	Average age 45.95	Average age 44.2	

The table lends but weak support to this view, for the average age in the failures is about the same as in the entire group. In the percentages, however, there is some downward trend of failures in the older decades, except for those in their seventies, in which there are only 7 cases. The 2.7 per cent difference in those above and below 50 years reflects this trend, but the difference is not striking. A larger series might raise these figures to the level of a significant difference.

Results in nationality groups: It has been said that certain races, notably the southern Europeans and Hebrews, tend to do poorly with gastroenterostomy. In this series the racial stock of the entire series and of the failures is as shown in Table IX.

TABLE IX

RACIAL STOCK	ENTIRE SERIES (%)	POOR RESULTS (%)
Hebrews	18.3	24.4
Italians	10.5	16.3
All others	71.2	59.3
Total	100.0	100.0

Though the differences are not striking, they bear out the general impression that the Hebrews and Italians tend to do less well than the other races. There were no notable differences in the other races, so they were grouped together.

Results in clinical groups: Another factor that has been considered of prognostic significance in gastroenterostomy is the clinical type of peptic ulcer. It is frequently said that obstructing ulcers do better than bleeding ulcers. To test the accuracy of this observation, the cases in this series are divided into three clinical groups, and the failures occurring in each group are determined. These groups are those with (1) hemorrhage, (2) obstruction, and (3) pain. It should be emphasized that the division of the cases into these groups is some-

what empirical, for there is considerable overlapping of clinical symptoms. For the purpose of this analysis the groups are defined as follows:

1. Hemorrhage: Cases that have had clinical evidence of bleeding at any time during the preoperative course, regardless of the presence of pain or obstruction. This includes both the serious bleeders, with hematemesis, tarry stools, and shock, and the milder bleeders with occasional tarry stools. It does not include those patients with obstruction or pain who may have occult blood in the stools or some changed blood in the emesis.

2. Obstruction: Cases that have had any appreciable evidence of gastric retention four hours after the barium meal. The x-ray criteria are used because a history of vomiting occurred in so many patients who had no obstruction. There is very little overlapping between those with obstruction and the bleeding group described previously. If the bleeding was a prominent symptom, they were classified as such, regardless of the presence of obstruction.

3. Pain: Cases that had pain, but no bleeding or obstruction. There is great overlapping between the pain cases and the two groups just described, for most patients had pain at some time during the preoperative course.

The distribution of the 270 operative survivors and the 49 poor results is as shown in Table X.

TABLE X

CLINICAL TYPE	CASES	POOR RESULTS	% POOR RESULTS
1. Hemorrhage	76	19	25.0
2. Obstruction	124	19	15.3
3. Pain	70	11	15.7
Total	270	49	

One might postulate that the ulcer that obstructs has demonstrated the greatest tendency to heal, that the ulcer that bleeds has the least tendency to heal, and that the ulcer with persistent pain lies somewhere between these two extremes. One might, with some rationale, group those with persistent pain and those with bleeding together, for in one sense severe hemorrhage is an incident in an active ulcer that depends upon whether or not the active ulcer has eroded a large vessel. But the rate of erosion and the fibrocytic response of the tissues to ulceration must also be factors in bleeding, for all portions of the gastrointestinal tract subject to ulceration are highly vascular. The greater incidence of failures in the hemorrhage group (25 per cent), as compared with the pain and obstruction groups (15 per cent), gives credence to the postulate outlined previously. Of the various clinical factors influencing failure, it appears that bleeding is more important than age or race.

Results in gastric ulcers: So far in this analysis, all operative survivors having gastroenterostomy for ulcer have been grouped together, regardless of the location of the ulcer. The primary pathology in the operative survivors is distributed as shown in Table XI.

Though the operation has not been used extensively on gastric ulcers, the end results in the 18 patients having had gastric or gastric and duodenal ulcer are

TABLE XI

PATHOLOGY	NUMBER OF CASES
Duodenal ulcer	252
Gastric ulcer	15
Duodenal and gastric ulcer	3
Total	270

of interest. There are not enough cases to warrant construction of a separate failure curve, for only 2 of the patients failed to do well. One of these had a large penetrating ulcer high on the lesser curvature, in which the symptoms were pain and vomiting without bleeding. At operation extensive inflammation and induration were found extending up to the esophageal hiatus, and removal of the lesion would have required an extensive procedure. He also had polycythemia vera, and died of a single massive hemorrhage three weeks after gastroenterostomy. The other patient had a duodenal ulcer with almost complete obstruction, a small penetrating gastric ulcer near the angularis, and bilateral pulmonary tuberculosis. Three months after gastroenterostomy a marginal ulcer perforated and was plicated. A secondary resection was done three years later for a persistent marginal ulcer, and this patient has now been well for one year. The remaining sixteen patients (89 per cent) have done well, and the average follow-up period since operation is 5.4 years. The average duration of symptoms before operation was 4.2 years.

The gastric ulcers were all on the lesser curvature, 6 in the lower one-third, 8 in the middle one-third, and 4 in the upper one-third. In most instances, gastroenterostomy was not considered the procedure of choice, but was done because of one or more circumstances that made the surgeon feel the lesser procedure expedient. Among these were age, poor condition of the patient, and local conditions that made resection hazardous. We cannot advocate gastroenterostomy for general use in gastric ulcers, largely because of the difficulty in being certain that the lesion is benign rather than malignant, but it may be that, in these cases, the combined risk of cancer and gastroenterostomy is less than the risk of total resection. There are other clinical situations encountered in which similar reasoning may apply, and in which choice of the lesser procedure may be the wiser decision. The main point to be made from this limited experience is that a gastric ulcer may do very well with gastroenterostomy, that all is not lost if the lesion cannot be resected, and that the surgeon must carefully reflect on these things before he undertakes unwarranted risks.

RESULTS OF TREATMENT OF FAILURES

The results of treatment of the 49 patients with poor results of gastroenterostomy can be summarized as shown in Table XII.

Results of Conservative Treatment.—It should be emphasized that most of the 49 patients with failures of gastroenterostomy received conservative treatment for the symptoms they had after operation. Twenty-six of these came to further operative treatment because this conservative treatment failed, while 10 were not subjected to surgery and remained failures. The net poor results are 36 cases which are charted in Fig. 2, *B*.

TABLE XII

TREATMENT	NUMBER OF CASES	PER CENT
Conservative treatment	23	47
Good results	13	56.5
Poor results	10	43.5
Net failures after conservative treatment*	36	
Operative treatment	26	53.0
Good results	20	77
Poor results	6	23
Net failures after both conservative and operative treatment†	16	

*See Fig. 2, *B*.
†See Fig. 2, *C*.

Of the 13 patients in whom results became satisfactory after conservative treatment, 6 had proved marginal ulcers, 6 had suspected marginal ulcers, and 1 had a gastric ulcer, while the primary ulcer was in the duodenum. These results have now remained satisfactory for an average of 5.2 years.

Of the 10 patients in whom conservative treatment remained a failure, 4 continue to have intermittent pain, 2 continue to have intermittent bleeding of a milder nature, and 4 are dead; 2 died of hemorrhage and 2 died of a perforated marginal ulcer. The fact that 4 of the 10 have died of ulcer emphasizes the risk incident to the prolonged conservative treatment of recurrent symptoms after gastroenterostomy.

Results of Operative Treatment.—Of the 26 patients who submitted to one or more secondary gastric operations, results in 20 are now good and results in 6 remain poor. Analysis of the operations is shown in Table XIII.

It is seen that 36 operations were done on the 26 patients who were treated surgically, with 3 operative deaths (8.3 per cent). Just half of the 26 failures

TABLE XIII. RESULTS OF TWENTY-SIX FAILURES TREATED SURGICALLY

FIRST OPERATION AFTER POSTERIOR GASTROENTEROSTOMY			SECOND OPERATION AFTER POSTERIOR GASTROENTEROSTOMY		
NUMBER OF CASES	TYPE SECONDARY OPERATION	RESULTS	NUMBER OF CASES	TYPE SECONDARY OPERATION	RESULTS
19	Dismantling and secondary gastric resection	Good—13 Poor—5 Operative death—1	1	Suture of perforated marginal ulcer	Good—1
2	Dismantling and resection of marginal ulcer	Poor—2	8	Secondary gastric resection	Good—6 Poor—2
1	Dismantling and pyloroplasty	Poor—1			
1	Dismantling and jejunal patch	Operative death—1			
1	Ligation of left gastric artery	Poor—1			
1	Plication perforated marginal ulcer	Poor—1			
1	Exploration for hemorrhage	Poor—1	1	Exploration for hemorrhage	Operative death
Total 26	Net good results	13	Total 10	Net good results	7

became good results after the first secondary operation, and 7 out of 10 became good results after the second secondary operation. In all, 20 became good results, and have been so for an average of 3.4 years after one or two surgical procedures following gastroenterostomy.

There were 6 out of 26 results that remained poor. These were 3 operative deaths (see Table XIII), 1 secondary resection that still has a marginal ulcer after one secondary resection, and 2 secondary resections that have marginal ulcers after two secondary resections. 1 of these last patients died of a perforated marginal ulcer.

It would seem clear from the evidence presented that the only effective secondary operation in this series was gastric resection. Every other procedure used in this series failed, except for one perforated marginal ulcer in a patient who has remained symptom-free for two years after simple plication. In all, there were 27 secondary resections done (19 and 8, see Table XIII), with 1 operative death, a mortality of 3.7 per cent.

Out of the original 49 failures of gastroenterostomy, there were 10 results that remained poor after conservative treatment, and 6 that remained poor after further operative treatment, leaving, at the time of writing, a net of 16 failures in the entire series of 270 operative survivors.

We can say that the patient subjected to gastroenterostomy has a 96.7 per cent chance of surviving the operation (and it may be 98 to 99 per cent); that if he does survive, he has a 78 per cent chance of being well thereafter; that he has an 88 per cent chance of being well without further surgery, even though he has some further trouble; that he has a 92 per cent chance of eventually being well, even though he has to have further surgery. In short, his chances of survival and eventually being cured are about 89 per cent.

COMMENT

It is apparent from the failure curve (Fig. 2, *A*) that one can expect about 25.2 per cent of patients after gastroenterostomy to have recurrent symptoms, usually within five years of the operation, and that about one-quarter of these will eventually become well without further surgery (Fig. 2, *B*). From the pathology found in the patients in whom the operation failed, it is clear that, if the recurrent symptoms are persistent, they are, in all probability, due to a marginal ulcer rather than to reactivation or persistence of the primary ulcer. Since most of the primary ulcers in this series (all but 1 gastric and 1 duodenal ulcer) healed after gastroenterostomy, it would appear that the procedure was a very effective method of dealing with the primary lesion. It would seem that much of the talk one hears about reactivation of duodenal lesions after gastroenterostomy is fallacious. Indeed, we are led to the general conclusion that, if the gastroenterostomy functions, the primary duodenal ulcer will heal, whether it be an obstructing ulcer, penetrating ulcer, or bleeding ulcer. The only exception in this series was the case described, in which the stoma functioned poorly. The only other exceptions we have observed (not in this series, occurred late, when involvement of the stoma by the marginal ulcer led to poor function of the stoma, and consequent reactivation of the original duodenal ulcer.

Effective as gastroenterostomy may be for treating the primary ulcer, it is perfectly clear that it often fails to prevent the formation of new ulcers. A more general way of stating this is that it often fails to interrupt the ulcer diathesis. The impression exists that gastric resection is more effective than gastroenterostomy in this regard, but we must not lose sight of the fact that resection also fails in certain cases. From the analysis of the secondary operations done, it is apparent that certain patients have such a marked ulcer diathesis that they do poorly with both gastroenterostomy and resection.

Comment should be made upon the selection of cases for gastroenterostomy in this series from all of the peptic ulcer cases in this hospital requiring operation. From 1932 to 1939 the surgical treatment of choice was gastroenterostomy except for those patients with either gastric ulcer or recent hemorrhage. During that period patients, both good and poor risks, coming to surgery for ulcer had gastroenterostomy. After 1939 resections were done more frequently, and the patients selected for gastroenterostomy were largely those with obstruction and the poor risks. Included in these were patients with extensive inflammation around the lesion and those in whom one would suspect that the ulcer diathesis, or the tendency to recurrence, was strong. In general, in all patients with a history of bleeding resection was done in the later years, while only in the recent and severe bleeders were resections done in the earlier period.

The question that comes to mind is what influence the selective policy after 1939 had on the poor results of gastroenterostomy. In the 171 operative survivors up to and including 1939, there were 36, or 21 per cent, poor results. In the 99 after 1939 there were 13, or 13 per cent, poor results. The percentage of poor results each year in the earlier period varies between 8 and 30 per cent, while that in the later period varies between 0 and 19 per cent (see Table XIV). Although the two groups are not truly comparable because of the shorter follow-up period of the second group, the data tend to support the selective policy. It is evident, however, that even in selected cases gastroenterostomy often fails, and that gastric resection is a stronger, though still imperfect, tool for interrupting the tendency to form ulcers.

TABLE XIV. DISTRIBUTION OF POOR RESULTS BY YEAR OF OPERATION

OPERATIVE YEAR	NUMBER OF POOR RESULTS
1932	1
1933	4
1934	8
1935	6
1936	6
1937	2
1938	7
1939	2
1940	3
1941	1
1942	0
1943	7
1944	2
1945	0
1946	0

It is probably accurate to state that most of the surgeons in this country have come to the feeling that gastroenterostomy is an inadequate and poor operation. This view, and the teachings incident to it, are open to some question in the light of the experience in this series. Until vagotomy has been evaluated, the alternative to gastroenterostomy is usually gastric resection. Had resection been attempted on all the patients in this series, the mortality would have been high, if not formidable, particularly in the group selected for gastroenterostomy since 1939, for among them were the poor risks. A comparative evaluation of gastroenterostomy will have to await the completion of similar studies of end results in gastric resection, but the low mortality and generally favorable outlook reflected in the failure curves strongly supports the view that gastroenterostomy is a useful and often curative procedure which has a definite place in the repertory of gastric surgery. It may be that the passage of time and the accumulation of experience will show that gastroenterostomy, supplemented by vagotomy in the cases where it fails, will give the lowest mortality and the highest incidence of cures.

LATE RESULTS FOLLOWING PERFORATED PEPTIC ULCER

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THE following study was undertaken to determine the end results in patients with perforated peptic ulcers operated upon in a large City Hospital. It has been stated that following suture of a perforated peptic ulcer, the ulcer heals and the patient is cured. There are those who do not agree with this statement and Harrison and Cooper[7] found that 82.5 per cent of patients continue to have symptoms.

One hundred and one patients treated on the Second Surgical (Cornell) Division of Bellevue Hospital from 1928 to 1945 for perforated peptic ulcer have been reviewed and, in particular, the follow-up results have been studied.

Sex.—As in all studies on this subject, males far outnumber female patients with perforated peptic ulcer. In this series there are 97 males and 4 females. There were 6 negroes of which 5 were males and 1 a female.

Age.—Although perforation of a peptic ulcer is reported in the newborn infant[10] and even before birth,[15] the usual age group is between 25 and 50 years. For this series the ages are as shown here:

3	13	21	27	28	8	1
10-20	21-30	31-40	41-50	51-60	61-70	71-80

It will be seen that the age group from 50 to 60 years showed most perforations, 28 in number, and over one-half (or 55) occurred between 41 and 60 years. The youngest patient was 18 and the oldest 71 years of age.

Season of Year.—Although there were more perforations in winter, the fact does not seem significant. There were 23 patients whose ulcer perforated in the fall, 33 in winter, 25 in spring, and 20 in the summer.

Preoperative Bleeding.—It has long been felt that bleeding ulcers do not perforate and that those that perforate do not bleed. Ulcers of the duodenum which perforate usually are on the anterior wall, while those which bleed tend to be on the posterior wall. Estes and Bennett[5] found that 26.9 per cent of perforations showed evidence of bleeding before operation. In this group of 101 perforations, 20 had had preoperative hemorrhage as evidenced by tarry stools or the vomiting of blood.

Chronic Symptoms.—Peptic ulcers may perforate without previous symptoms, however, White and Patterson[19] are correct in stressing the point that careful history taking usually will elicit chronic symptoms. Twenty-three of these patients are reported to have had no chronic symptoms while in the others symptoms had been present for from three months to thirty years. The duration of symptoms is given here:

Cases	13	5	8	8	5	3	10	2	2	6	0	8	3	2	1	1
Years	¼	½	1	2	3	4	5	6	7	8	9	10	15	20	26	30

Acute Symptoms.—At times it is hard to evaluate the onset of acute symptoms caused by a perforated ulcer. The large majority of patients in this series were seen within six hours of the perforation, but one patient came in to the hospital three days after the ulcer perforated.

Time of Perforation.—It is supposed that ulcers perforate most frequently after the consumption of a large meal or after indulgence in alcoholic beverages and that this may account for the higher incidence of perforations in winter. In this series, perforations occurred after eating or drinking in 14 patients, and while in bed in 27; of the latter 8 perforations occurred while the patient was in a hospital bed being treated for symptoms of ulcer. Twenty-four patients were working or walking when the perforation occurred; 9 had taken a laxative before the perforation occurred.

Site of the Ulcer.—The number of duodenal ulcers as compared with gastric ulcers which perforate varies with reports, but the duodenal ulcers usually far outnumber the gastric. Heuer[1] recorded 40 duodenal to 17 gastric, Estes and Bennett[5] 63 duodenal to 16 gastric and Harrison and Cooper[7] 51 duodenal to 6 gastric. Our series of 101 cases shows 17 in the duodenum and 84 in the stomach. Of the 84 ulcers in the stomach, 29 were classified simply as gastric, 42 as prepyloric, 9 as pyloric, and 4 as situated at the cardiac end.

Mortality.—Following operation on the 101 patients there were 18 deaths, an operative mortality of 18 per cent. The relation of mortality to length of time between perforation and operation is interesting. It was found that the mortality under six hours was 11.8; between six and twelve hours, 22.5; between twelve and forty-eight hours, 33.3; and over forty-eight hours, 50 per cent (Table I). This fact has been brought out by Dineen[16] (Table II) and also by Sallick[18] (Table III).

TABLE I. ONE HUNDRED ONE CASES OF PERFORATED PEPTIC ULCER

NUMBER OF CASES	TIME BETWEEN PERFORATION AND OPERATION (HR.)	DEATHS	PER CENT
65	Under 6	8	11.8
17	6-12	4	22.5
9	12-48	3	33.3
2	Over 48	1	50.0
8	Unknown		

This table shows the relation of mortality to length of time between perforation and operation.

TABLE II. RELATIONSHIP OF MORTALITY TO TIME OF OPERATION IN DINEEN'S SERIES (142 CASES)

NUMBER OF CASES	HOURS AFTER PERFORATION	DEATHS	MORTALITY PER CENT
94	Under 6	7	7
32	6-22	11	31
16	Over 22	13	81

TABLE III. RELATIONSHIP OF MORTALITY TO TIME OF OPERATION IN SALLICK'S SERIES (74 CASES)

NUMBER OF CASES	HOURS AFTER PERFORATION	DEATHS	MORTALITY PER CENT
49	6	1	2
13	6-12	2	15
10	12-48	3	30
2	Over 48	2	100

Type of Operation.—In this group of perforations, simple suture was carried out in 98 patients; on 2 a posterior gastroenterostomy was added to simple suture and in 1 omentum alone was used to cover the defect.

Follow-up Studies.—It is difficult to find and follow every patient who comes into a large City Hospital, as many of them have no home nor address. The longest follow-up record in this series is eleven years. In 26 patients there are no follow-up reports. We strongly suspect that in this group of unfollowed cases may be some of our best as well as some of our worst results. Of the entire series, 18 patients died and 26 were not followed; 10 were followed less than six months, 8 more than six months, 11 more than one year, 11 for two years, 5 for three years, 3 for four years, 6 for five years, 1 for six years, 1 for seven years, and 1 for eleven years.

In order to evaluate results, all patients who could be followed were seen and examined; many had x-ray examinations and also, in a large number subsequent operations gave much information. There is no standard method of presenting follow-up studies; our cases were divided into four groups, as follows:

1. Excellent result: no symptoms; able to work; x-ray evidence of healing of ulcer or no ulcer.
2. Good result: mild symptoms controlled by therapy; no loss of time from work because of ulcer; x-ray evidence of healing ulcer.
3. Fair result: symptoms fairly well controlled by therapy; some loss of time from work because of ulcer; x-ray evidence of active ulcer.
4. Poor result: symptoms not controlled by diet; able to do very little work; active ulcer by x-ray examination; repeated hospitalization; operation.

Duodenal Ulcer.—There are in the series 17 patients who had duodenal ulcers which perforated. Two of these patients died, a mortality of 12 per cent. In the surviving patients there were 4 with excellent results, none with good, 3 with fair, 6 with poor results, and 2 in whom follow-up was not possible. By combining the excellent and good results and the fair with the poor results, we have 4 satisfactory and 9 unsatisfactory results. It certainly is clear from this that simple suture of a perforated duodenal ulcer is not the ultimate solution of the problem (Table IV).

Gastric Ulcer.—In the group of gastric ulcers there were 84 perforations. Sixteen of these patients died postoperatively, an operative mortality of 19.0 per cent. In the follow-up records 9 are classified as excellent, 6 as good, 12 as fair, and 17 as poor. In 24 cases there was no follow-up. If we combine these results as in the duodenal group we find 15 which can be considered satis-

TABLE IV. PERFORATED DUODENAL ULCERS
(SEVENTEEN CASES)

RESULTS			NUMBER
Excellent	4	Satisfactory	4
Good	0		
Fair	3	Unsatisfactory	9
Poor	6		
Not followed	2		
Deaths	2		
Mortality	12.0%		

factory and 29 unsatisfactory (Table V). Again, a simple suture of a perforation of gastric ulcers leaves much to be desired. When the causes of the unsatisfactory results are studied, certain facts stand out clearly—namely, that perforation is only one complication in the life history of an ulcer which may include all the major complications such as reperforation, bleeding, obstruction, and intractable pain.

Reperforation.—The complication of reperforation occurs following each type of ulcer and also each type of operation performed. Estes and Bennett[5] found reperforation in 7 of 61 patients treated by simple suture (11 per cent). Williams[6] in 100 cases reviewed, found a secondary perforation in 3 patients after simple suture.

Royster[12] reported a gastric ulcer high on the greater curvature of the stomach in a young woman 23 years of age, which perforated five times. At the second operation, the ulcer and perforation were in the exact site of the previous perforation; however, on 3 subsequent occasions in which a perforation was diagnosed, clinically by x-ray examination because of obliteration of hepatic dullness and gas under the diaphragm, conservative treatment was carried out. This case illustrates three points: (1) that when symptoms of ulcer continue, the ulcer has failed to heal; (2) that perforation and suture do not guarantee healing, and (3) that each reperforation encounters increased resistance to infection in the abdominal cavity and a quicker walling off of the perforation.

Lysaght[13] reported a patient 26 years of age whose father died of a perforated peptic ulcer at 34 years of age. The son within a period of fifteen months suffered four perforations of an ulcer on the anterior wall of the pylorus. Each time the perforation was in the same location. Between the second and third perforations, a posterior gastroenterostomy was performed and following the fourth, a gastric resection. Three months following the resection the patient was reported to be well.

TABLE V. PERFORATED GASTRIC ULCERS
(EIGHTY-FOUR CASES)

RESULTS			NUMBER
Excellent	9	Satisfactory	15
Good	6		
Fair	12	Unsatisfactory	29
Poor	17		
Not followed	24		
Deaths	16		
Mortality	19.0%		

Herten-Greaven[11] also reported a patient 21 years of age with a gastric ulcer low on the lesser curvature which perforated three times within a period of four years. Again in this patient, each perforation appeared to be in the same location.

Henry[17] had a patient with a large recent perforation on the anterior wall of the stomach. This was closed and an anterior gastroenterostomy was performed. Following this procedure the patient had three perforations of a jejunal ulcer within a period of four years, and then, three months later a fifth perforation, this time again in the gastric ulcer. All five perforations occurred within a period of five years.

Pearse[14] in a careful review of the literature on reperforation examined reports of 4,813 cases and found 33 instances of recurrent perforation, a percentage of 0.69. The mortality for recurrent perforation was 9 per cent while that for perforated ulcers in general was 27 per cent. Pearse concluded that the incidence of reperforation is the same regardless of the type of primary procedure. However, in our series simple suture and simple suture plus gastroenterostomy were the operations most frequently used (Table VI).

TABLE VI. REPERFORATION OF PEPTIC ULCER IN PEARSE'S SERIES

OPERATION	NO.	PER CENT	REPERFORATIONS NO.	REPERFORATIONS PER CENT
Simple suture	710	67.0	24	72.0
Suture & P.G.E	281	26.6	8	24.3
All others	65	6.2	1	3.0
Mortality				
Perforated		27.0		
Reperforated		9.0		
Total				
Perforations	4813			
Reperforations	33	0.69		

In our own series of 101 patients with perforation there were, to our knowledge, 5 who suffered a second perforation, a percentage of 5.0. When only those surviving the first operation are considered, the percentage is over six, or almost ten times that found by Pearse.[14] In the group of patients with reperforation there was 1 death, a mortality of 20 per cent. This reperforation occurred six days after the first and may be considered a postoperative complication.

Bleeding.—Estes and Bennett[5] reported that in 26.8 per cent of patients with perforation in his series there was bleeding prior to the perforation. In this series the figure is 20 per cent. Following operation for perforated ulcer, 4 patients had evidence of massive hemorrhage for which additional surgery was carried out.

Obstruction.—In 6 patients a secondary operation was carried out for obstruction.

Intractable Pain.—There were 2 subsequent operations for intractable pain.

Carcinoma.—Reports concerning the possibility of ulcer developing into carcinoma vary. Williams[6] reported one secondary operation for carcinoma following a perforated ulcer. In our series there has been no evidence of cancer. It seems that gastric ulcers rarely become malignant.

Secondary Operations.—Secondary operations were carried out in 17 cases as follows:

Reperforation:	(1) Suture of perforation.
	(2) Reperforation on sixth postoperative day; died.
	(3) Suture of reperforation one year after primary suture.
	(4) Suture of reperforation.
	(5) Suture of reperforation followed later by gastric resection.
Hemorrhage:	(1) For massive hemorrhage five years later.
	(2) Gastric resection for bleeding duodenal ulcer.
	(3) Pylorectomy for bleeding ulcer.
	(4) Gastroenterostomy for bleeding ulcer.
Obstruction:	(1) Posterior gastroenterostomy for obstruction.
	(2) Anterior gastroenterostomy for obstruction.
	(3) Gastric resection for obstruction.
	(4) Gastric resection for obstruction.
	(5) Gastric resection for obstruction.
	(6) Gastric resection for obstruction.
Intractable Pain:	(1) Posterior gastroenterostomy for intractable pain.
	(2) Gastric resection for intractable pain.

It is quite clear that, although the immediate results of surgery for perforated ulcer are good, the late results, as determined by follow-up studies, are poor. This leads to the question, whether we can modify the late results by the type of operation performed at the time of the first perforation. Attempting to solve this question has led to many different procedures and various answers. In the main there are three schools of thought: (1) Those who advocate the least possible surgery and close the perforation by the simplest method; (2) those who combine closure with gastroenterostomy; and (3) those who resect the stomach and perforated ulcer at the same time.

Simple Closure of Perforation.—Many surgeons feel that these patients are poorly prepared for operation and that the simplest surgery possible is the best, in the attempt to lower the initial mortality. The perforation is closed by simple suture usually with reinforcement of the suture line by a small tab of omentum. Even though at times the pyloric opening is somewhat compromised, this group of surgeons feels that additional surgery is unnecessary. DeBakey,[3] in a collected series of 1,525 perforations closed by simple suture, found that over one-half the patients, or 65 per cent, remained symptom-free, 35 per cent continued to have symptoms, and 16.9 per cent required subsequent surgery (Table VII).

In our series of 57 patients on whom follow-ups were carried out after treatment by simple suture, there were 13 excellent, 6 good, 15 fair, and 23 poor results; or to combine them as satisfactory and unsatisfactory, there were 19 of the former and 38 of the latter. The unsatisfactory cases thus constituted 66 per cent of those followed, and 29.8 per cent of those followed have required subsequent surgery.

TABLE VII. RESULTS OF OPERATIONS IN 2670 CASES (DE BAKEY, 1940)

PROCEDURE	NUMBER	PER CENT	
Simple closure	1525		
Symptom-free		65	
With symptoms		35	
Subsequent operation			16.9
Simple closure plus gastroenterostomy	764		
Symptom-free		67	
With symptoms		33	
Subsequent operation			4
Partial gastrectomy	385		
Symptom-free		81.8	
With symptoms		18.2	

Simple Closure Plus Gastroenterostomy.—It is the opinion of others that patients with perforated ulcer operated upon within six or twelve hours are good operative risks and have only a chemical peritonitis without bacterial involvement. In addition, they feel that by simple suture the outlet of the stomach often is obstructed. With this in mind, they combine simple suture with gastroenterostomy. They point to immediate mortality figures which are no higher than those given for simple closure. They admit that gastroenterostomy is used only for good-risk patients operated upon shortly after perforation; for others a simple closure only is done. DeBakey[3] in his review of 764 collected cases of patients treated by this method found 67 per cent permanently relieved, which is the same as the percentage following simple closure. On the other hand, only 4 per cent required subsequent operation as compared to 17 per cent following simple closure (Table VII).

Gastric Resection.—European surgeons have for a long time been pioneers in the use of gastric resection for the treatment of peptic ulcer (Billroth, Polya), and as one would expect, they also have treated perforated ulcer by gastric resection with a low reported mortality rate. Again, this is in good-risk patients and shortly after perforation. DeBakey[3] in 385 collected cases found 81.8 per cent of patients treated by gastric resection to be symptom-free. Bisgard[4] in an excellent review of the literature concluded that subtotal gastric resection can be performed in the presence of diffuse soiling of the peritoneal cavity within twelve hours after perforation of ulcerated lesions of the stomach, duodenum, and jejunum in good-risk patients with a lower mortality than that obtained by simple suture. He also added that with few exceptions the resection results in permanent cure in contrast to the high incidence of recurrent ulceration following simple closure of the perforation.

CONCLUSIONS

The following conclusions have been drawn from our study. Patients with perforated ulcers should be operated upon promptly. The perforation should be closed by simple suture. When simple suture causes obstruction, it should be combined with gastroenterostomy. No drainage is employed in the abdominal wound. Patients with persistent symptoms and/or an active ulcer at the end of six months after operation, and while on adequate medical treatment, should have an additional operative procedure.

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NEUROGENIC TUMORS OF THE STOMACH

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TUMORS derived from the nerve sheath are not common in the stomach. Because of the confusion in terminology and the difference of opinion among pathologists in the interpretation of their histopathology, these tumors are variously described as neurofibromas, schwannomas, neurolemmomas, neurinomas, and perineural fibroblastomas.[1-3]

It is difficult to estimate their true incidence, for neurogenic tumors of the stomach are often confused with neoplasms derived from smooth muscle. However, Minnes and Geschickter,[4] in 1936, collected 931 reported cases of benign tumors of the stomach and classified 102, or 10.9 per cent, as neurofibromas.

A review of reported cases of tumors classified as being of nerve sheath origin and those believed to be derived from smooth muscle reveals great similarity in the clinical features, in gross appearance, and in microscopic structure.[3, 5-11]

We do not wish to enter the controversy concerning the histogenesis of these tumors.[12] Our principal objective is to emphasize two important clinical features of these lesions, first, the tendency of the gastric mucosa over the tumor to ulcerate and cause serious bleeding, and, second, the possibility of malignant transformation.

This report is concerned primarily with eight patients operated upon at St. Luke's Hospital and found to have gastric tumors of nerve sheath or smooth muscle origin. Six tumors have been classified as neurofibromas, one as a neurogenic sarcoma, and one as a leiomyoma, probably malignant (Table I). Six of the patients were admitted to the hospital because of gastrointestinal bleeding, one because of vague epigastric distress, and one because of epigastric pain which apparently was due to a duodenal ulcer. Five of the tumors were found in the cardiac portion of the stomach and three in the pyloric region. Four were removed by local excision and four by gastric resection. There were no deaths and the seven patients on whom we were able to do follow-up studies have remained well to date, two more than five years and five less than one year.

CASE REPORTS

CASE 1 (92901).— P. N., a 41-year-old man, was admitted to the hospital in April, 1932, because of a severe gastric hemorrhage. The patient gave a history of postprandial pain of five years' duration. The admission blood count showed a hemoglobin of 29 per cent and 1,440,000 red cells per cubic millimeter of blood. Roentgenograms, two weeks after admission, failed to reveal any gastric pathology, and gastric acidity was found to be normal. The patient was discharged with the clinical diagnosis of bleeding duodenal ulcer. Eighteen months later he returned to the hospital because of a second severe hemorrhage. Roentgenograms at this time showed a tumor at the pyloric end of the stomach. The tumor and the pyloric portion of the stomach were removed by a Billroth I type of gastric resection. The postoperative course was uncomplicated. Unfortunately, we were unable to maintain contact with the patient after his discharge from the hospital.

TABLE I. NEUROGENIC TUMORS OF THE STOMACH

CASE NUMBER	SEX	AGE (YR.)	CHIEF COMPLAINT	LOCATION OF TUMOR	OPERATION	DIAGNOSIS	RESULT
1	M	41	Bleeding (acute)	Pylorus	Gastric resection	Neurofibroma, ulcerated	No follow-up
2	F	46	Epigastric distress	Cardia	Local excision	Neurofibroma	Well 7 yr.
3	M	51	Pain	Pylorus	Gastric resection	Neurofibroma, ulcerated; duodenal ulcer	Well 5 yr.
4	F	64	Fatigue, bleeding (chronic)	Pylorus	Gastric resection	Neurogenic sarcoma, ulcerated	Well 1 yr.
5	M	51	Bleeding (acute)	Cardia	Gastric resection	Neurofibroma, ulcerated	Well 9 mo., no appetite
6	F	50	Bleeding (acute)	Cardia	Local excision	Neurofibroma, ulcerated	Well 6 mo.
7	F	33	Bleeding (acute)	Cardia	Local excision	Neurofibroma, ulcerated	Well 2 mo.
8	F	61	Bleeding (acute)	Cardia	Local excision	Leiomyoma, ulcerated (?) malignant	Well 2 mo.

Gross Pathology.—The excised portion of stomach was 9 cm. long on the greater curvature. Just proximal to the pylorus and partially involving it, there was a large tumor (Fig. 1) measuring 10 by 10 by 5 cm. which projected into the lumen of the stomach. The mucosa over the tumor was intact, except at the site of a deep ulcer, 2 cm. in diameter and from 1 to 3 cm. deep. The mucosal border overhung the ulcer base. The tumor was well encapsulated and was only loosely attached to the muscularis and mucosa.

Microscopic Examination.—Sections of the stomach showed portions of an ulcer with an indolent necrotic base and margins which showed only slight hyperplasia of the epithelium. There was a considerable degree of inflammation in the stroma. The base of the ulcer extended through the submucosa into the tumor mass. The tumor was fairly discrete, and consisted of spindle-shaped cells with considerable intercellular gelatinous material and a smaller amount of hyaline degeneration. The form of the cells and their spindle-shaped arrangement, with palisading nuclei and some giant nuclei, was characteristic of the perineural fibroblastomas. In some areas swollen and hypertrophied tortuous nerve trunks could be seen at the periphery of the solid tumor masses. The submucosa showed chronic infection. The muscle coat showed very little change. This tumor appeared benign.

Diagnosis.—Diagnosis was neurofibroma of the stomach with chronic ulcer.

CASE 2 (A-17476).—R. W., a 46-year-old woman, was admitted to the hospital in May, 1939, because of mid-epigastric pain of one year's duration. This pain had no relation to meals and there had been no evidence of bleeding. Roentgenograms revealed a tumor of the cardiac portion of the stomach. At operation a nonulcerated tumor, 4 by 4 by 2 cm. in size, was found in the posterior wall of the cardia of the stomach. This was excised after opening the stomach through the anterior wall. The postoperative course was uncomplicated. The patient has remained well to date, seven years.

Gross Pathology.—The tumor from the stomach wall (Fig. 2) was a rough brownish oval, 4 by 1.3 by 1 cm. Section showed a solid mass with grayish surface. There were thin fibrous bands dividing the tissue irregularly.

Microscopic Examination.—Section (Fig. 3) of the tumor showed a growth composed of edematous, vacuolated fibrillar material with rather infrequent nuclei. These were usually short with blunt ends and did not contain mitoses. They had the general appearance of fibroblasts and although there was no definite palisading, the growth had many of the characteristics of a tumor of the nerve sheath. It did not appear to be malignant.

Diagnosis.—Diagnosis was neurofibroma of the stomach.

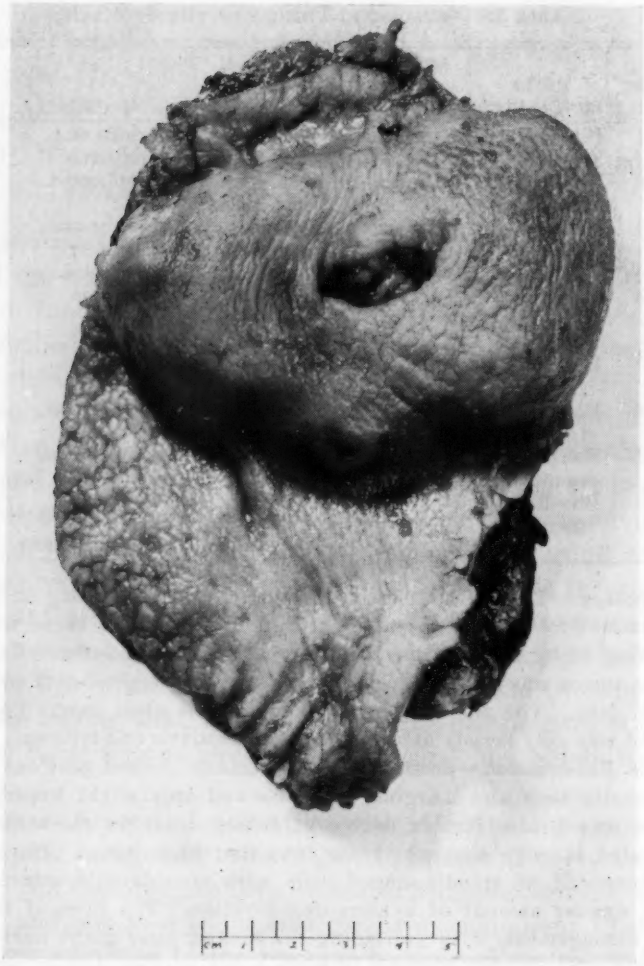

Fig. 1 (Case 1).—Neurofibroma of pyloric region of stomach showing a central area of ulceration.

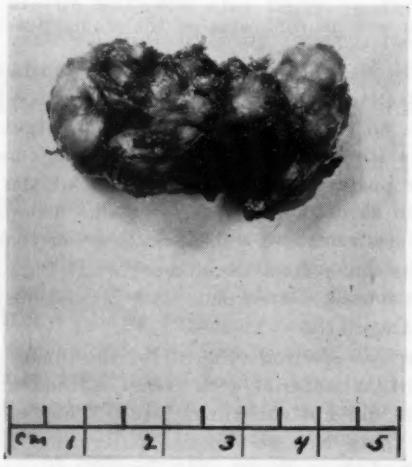

Fig. 2 (Case 2).—Neurofibroma from cardia of stomach; there is no ulceration.

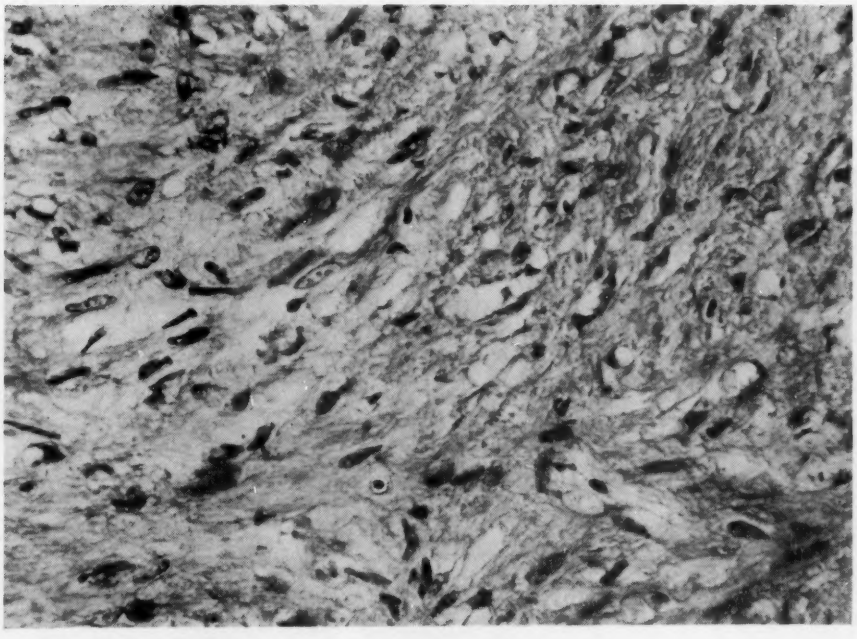

Fig. 3 (Case 2).—Section through tumor showing edematous, vacuolated fibrillar material with rather infrequent nuclei (×375).

CASE 3 (A-72054).—P. Q., a 51-year-old man, was admitted to the hospital in January, 1942, because of postprandial pain, of twenty-five years' duration, relieved by food and soda. The pain had become more severe during the six months prior to admission. There was no history of bleeding. Roentgenologic studies showed an irregularly deformed duodenal cap and gastric acidity was elevated. At operation the patient was found to have a duodenal ulcer and a freely movable tumor, 3 cm. in diameter, in the lesser curvature of the stomach near the pylorus (Fig. 4). A Polya type of gastric resection was done. The patient's postoperative course was uncomplicated and he has remained well to date, five years.

Gross Pathology.—The portion of the excised stomach measured 17 cm. in length at the greater curvature and 8 cm. at the lesser curvature. The surface was normal in appearance except at a point, 2 cm. from the pyloric end, where there was a projecting mass, 3 by 3.5 cm. in size, on the lesser curvature. The serosa over the mass was somewhat congested. On section, it appeared to lie between the muscularis and the mucosa and extended inward to the mucosa, which was ulcerated. It was firm in consistency, pale, and had a smooth cut surface.

Microscopic Examination.—Section (Fig. 5) showed a small ulcer of the chronic type with the base in the submucosa. It was covered with a large amount of fibrin. Underneath this, there was a small amount of scar tissue in which were many large bundles resembling nerve trunks with proliferation of the cells of the neurilemma. These trunks extended down through the muscle. In one area there appeared to be muscle left in the base of the ulcer but only fibrous tissue and large nerve bundles. The nodules showed a lobulated structure made up of twisted bundles in which the nuclei had a palisading arrangement. Some were vacuolated and the small rounded globules suggested mucoid degeneration. This is often seen in tumors which have originated in sheaths of Schwann. The growth appeared benign.

Diagnosis.—Diagnosis was neurofibroma of the stomach, with ulcer.

CASE 4 (A-114-909).—C. J., a 64-year-old woman, was admitted to the hospital in January, 1946, complaining of fatigue, palpitation, and epigastric distress of nine months' duration. There was no history of vomiting and the patient had not observed the color of the stools. On admission, the patient's hemoglobin was 35 per cent and the red cells were

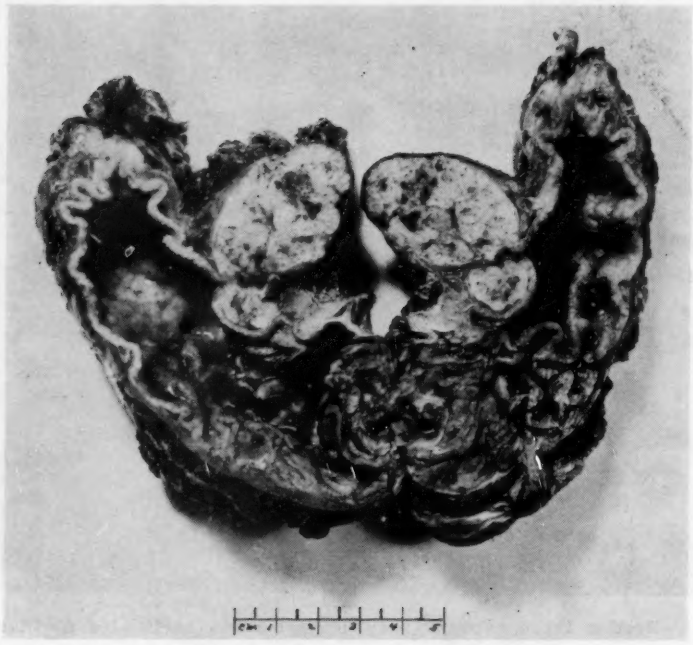

Fig. 4 (Case 3).—Neurofibroma on lesser curvature of stomach, near pylorus.

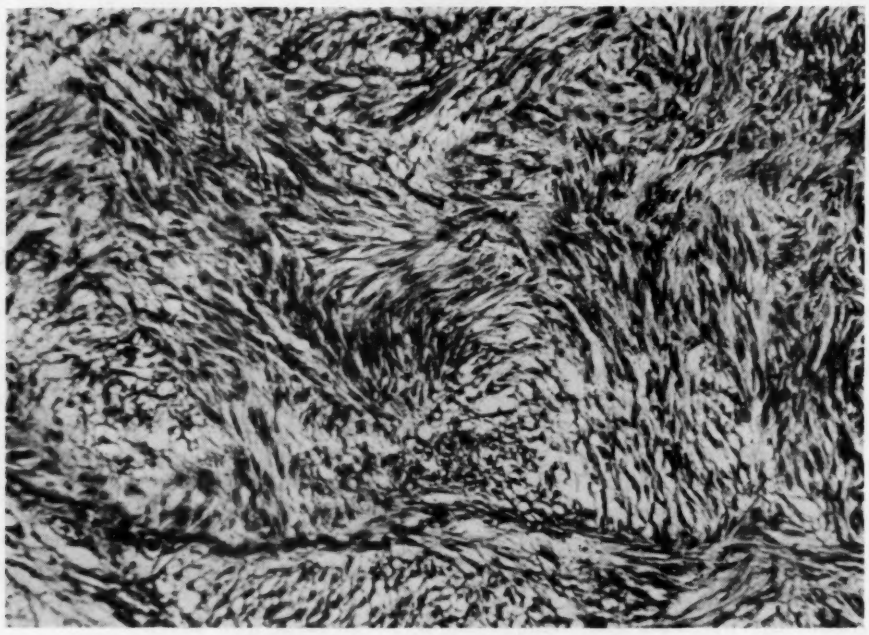

Fig. 5 (Case 3).—Section through tumor showing twisted bundles in which the nuclei have a palisading arrangement. Small rounded globules suggest mucoid degeneration (×150).

2,000,000 per cubic millimeter of blood. The stools contained blood. Roentgenogram (Fig. 6) showed a polypoid mass 5 cm. in diameter on the lesser curvature of the stomach and about 5 cm. from the pylorus. Gastric acidity was low. On Jan. 24, 1946, the ulcerated area, which appeared benign, was excised. The pathologic diagnosis, however, was neurogenic sarcoma.

Fig. 6 (Case 4).—Roentgenogram showing tumor in prepyloric area of stomach.

Gross Pathology.—The specimen consisted of a portion of the wall of the stomach 5 by 5 by 3.5 cm. There was an ulcer, 8 mm. in diameter, on the anterior surface, toward the lesser curvature. Section through this showed a thick hypertrophied underlying muscularis.

Microscopic Examination.—Section (Fig. 7) through the base of the ulcer showed it to be composed of tumor which had apparently arisen from a nerve trunk. The growth extended up to the mucosal surface, being covered with only a very little exudate, and replaced the normal tissues down to the muscle coat. The latter was thickened by fibrosis, hypertrophy, and edema. The tumor was made up of twisted strands of spindle-shaped cells of the connective tissue type; some of them, seen in longitudinal section, were rather plump with rounded ends. The fibers were closely packed together, showed very little

myxomatous degeneration, but practically no collagen. There were a few areas in which the nuclei were palisading and in these the appearance was that of a neurogenic tumor. There were a few mitotic figures and the tumor was too cellular to be regarded as benign, but it was of a type which would be unlikely to metastasize at this early stage. It is possible that it had not been entirely removed.

Diagnosis.—Diagnosis was neurogenic sarcoma of the stomach, ulcerated.

Because of this diagnosis, the patient was returned to the hospital and on March 7, 1946, a partial gastric resection was done. No tumor, gross or microscopic, was recognized in the portion of stomach removed. Convalescence was uncomplicated and the patient has remained well to date, one year.

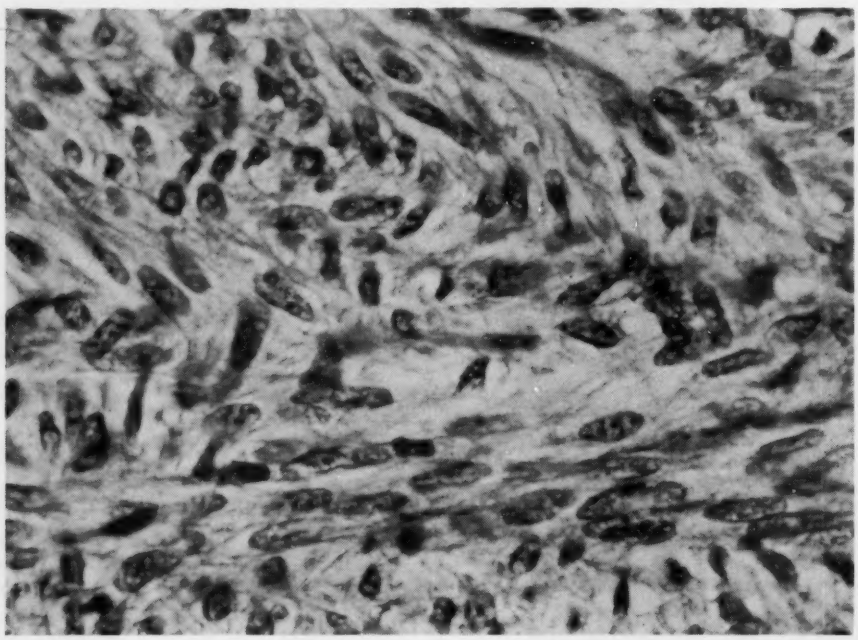

Fig. 7 (Case 4).—Neurogenic sarcoma; this tumor is very cellular with some palisading of the nuclei and a few mitotic figures (×875).

CASE 5 (A-118-493).—H. M., a 51-year-old mechanic, was admitted to the hospital in April, 1946, because of severe gastrointestinal bleeding. He had noted tarry stools for one week and the day before admission vomited a large amount of bright red blood and fainted. On admission the hemoglobin was 27 per cent and there were 1,120,000 red cells per cubic millimeter of blood. After a period of two weeks the stools were free of blood and the roentgenograms (Fig. 8) taken at this time showed an ulcer crater on the posterior wall of the stomach about 4 cm. from the esophagus. At operation, performed two months after admission, an ulcerated tumor (Fig. 9) was found in the posterior wall of the stomach near the esophagus. The tumor was removed by a high gastric resection, which left about 3 cm. of the stomach attached to the esophagus. A left subphrenic abscess developed and was drained two weeks after the resection. There was rapid improvement in the patient's condition and the course since has been fairly satisfactory, although he still has some discomfort immediately following meals. He was discharged from the hospital Aug. 20, 1946, two months after resection, in good condition and with the drainage wound healed. Nine months after operation he appeared well but had not regained his normal weight and still complained of anorexia.

Gross Pathology.—The specimen consisted of cardia and fundus of the stomach with a tumor in the posterior wall. On the greater curvature it measured 17 cm. and on the lesser

12 cm. The distal half appeared normal, but, beginning at the site of resection at the proximal end, there was a large irregular mass extending from the mucosa entirely through the wall and forming a nodular mass 6 by 8 by 6 cm. On the inner surface, the mucous membrane was stretched over the tumor, which protruded into the stomach cavity for a distance of 4 cm. In the center there was a deep ulcer 2 by 2 by 2 cm. The mucosal edges were overhanging, the base was smooth and composed only of tumor. On the serous surface the tumor protruded, forming a mass 4 by 5 by 3 cm. Section showed that the tumor was composed of firm bluish-white trabeculae, small hemorrhagic areas, and small cavities.

Fig. 8 (Case 5).—Roentgenogram showing a deep ulcer in the posterior wall of stomach.

Microscopic Examination.—Section (Fig. 10) through the base of the ulcer showed a necrotic area with some fibrous tissue and tumor and many thrombosed vessels. Beneath this the tumor extended to the serous surface, and showed considerable infection and edema. It was composed of large twisted bundles of spindle-shaped cells with long pointed nuclei, some of which were arranged to suggest the neurilemma. The nuclei showed frequent cross striations due to mucinous degeneration such as takes place in Schwann cells. There were numerous areas in which these mucoid inclusions had distended and enlarged the cell bodies, pushing aside the nuclei. Mitoses were not seen, although the tumor was fairly cellular and the nuclei were hyperchromatic. It would appear, however, that the growth was probably relatively benign.

Diagnosis.—Diagnosis was neurofibroma of the stomach, ulcerated.

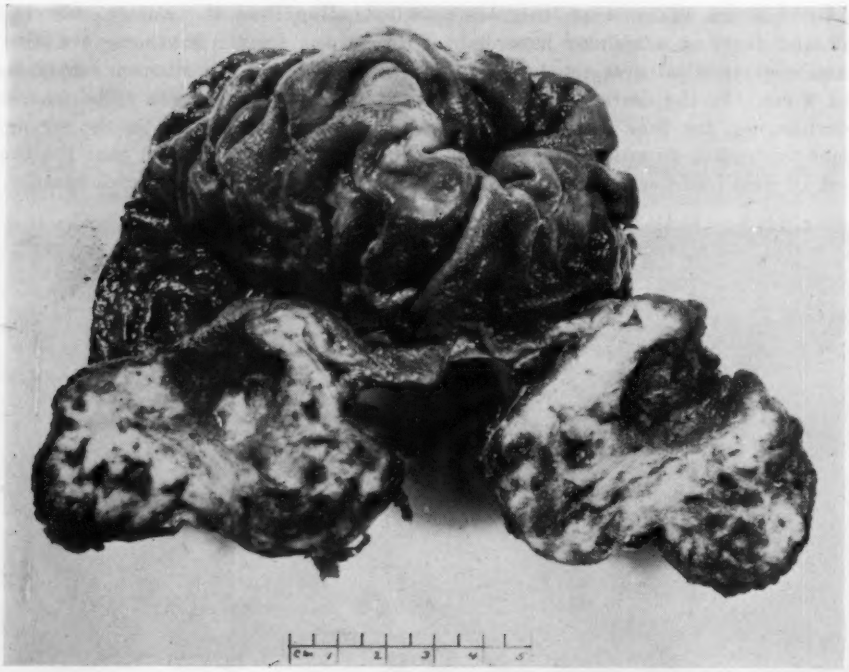

Fig. 9 (Case 5).—Neurofibroma from posterior wall of stomach showing a central area of ulceration.

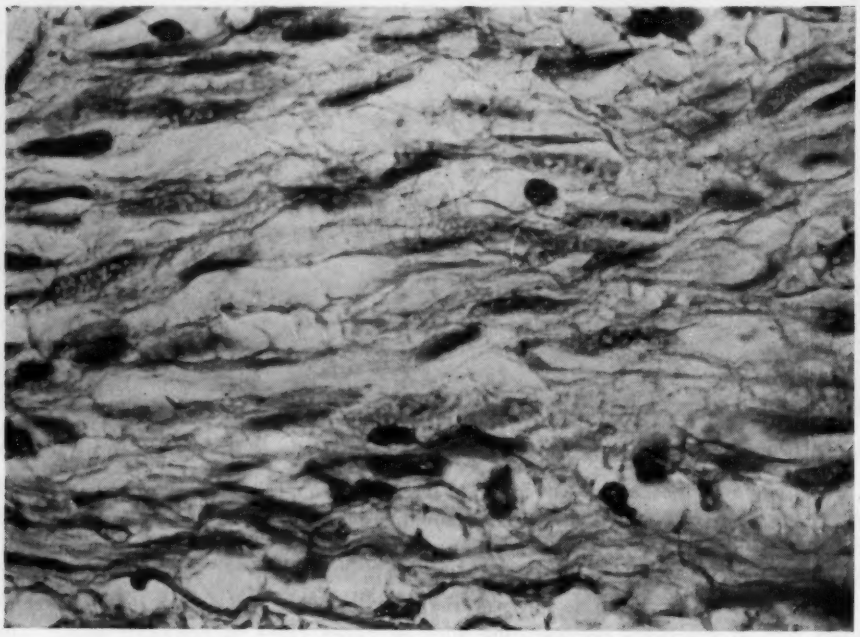

Fig. 10 (Case 5).—Section through tumor showing spindle-shaped cells with long pointed nuclei and rather marked mucinous degeneration (×875).

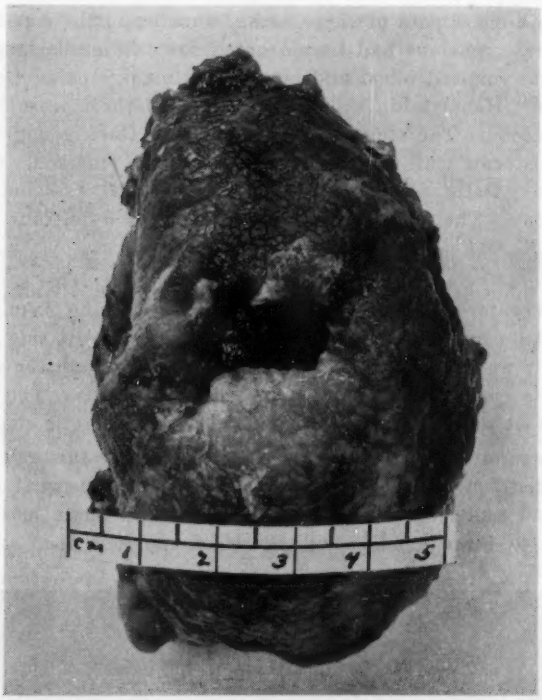

Fig. 11 (Case 6).—Neurofibroma from posterior wall of stomach showing a large central ulcer.

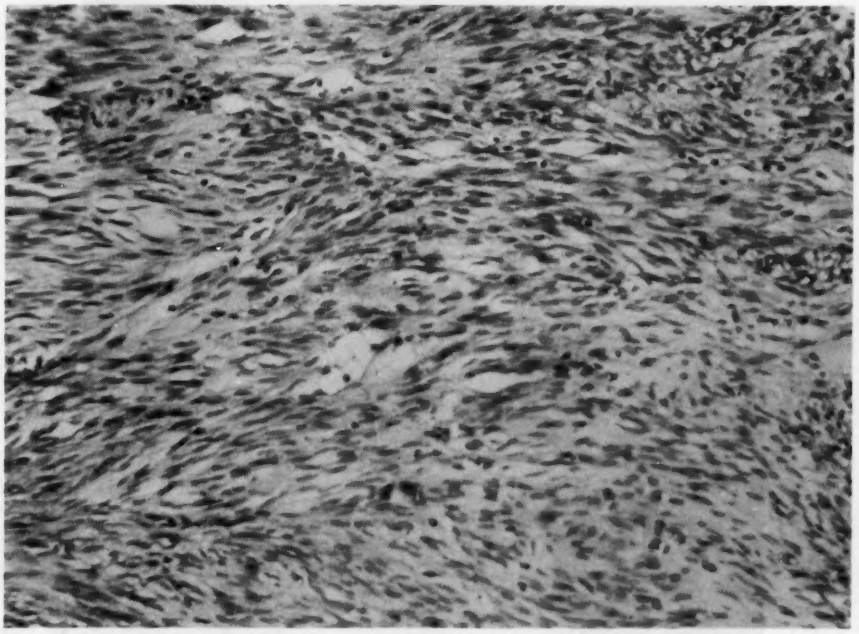

Fig. 12 (Case 6).—Section through tumor showing bundles and whorls of spindle-shaped cells with palisading nuclei (×187.5).

CASE 6 (A-108-503).—H. P., a 51-year-old woman, was admitted to the hospital Oct. 8, 1946, because of severe chest pain of three hours' duration. She was known to have hypertension and on several occasions had been treated for cardiac decompensation. One week prior to admission she vomited blood and later noted black stools. On admission the blood pressure was 220/110. Hemoglobin was 76 per cent and there were 3,700,000 red cells per cubic millimeter of blood. The stools contained blood. Roentgenograms showed an ulcerated tumor of the posterior wall of the cardiac end of the stomach. On Nov. 8, one month after admission, the gastric tumor was removed by local excision. The postoperative course was satisfactory. The patient has remained well to date, four months.

Gross Pathology.—The specimen consisted of a tumor (Fig. 11) from the stomach measuring 8 cm. in length, 4½ cm. in width, and 3½ cm. in depth. One surface was covered with gastric mucosa at the center of which was an ulceration measuring 2 cm. in diameter and 2 cm. in depth, but 4 cm. at its base. The serosal surface on the opposite side of the tumor appeared smooth. On section it was noted that the tumor extended through the entire thickness of the stomach wall and was composed of firm, yellowish white tissue. The ulcer undermined the edges and was widest at the base which was covered with a necrotic slough.

Microscopic Examination.—Section (Fig. 12) through the tumor including the mucosa of the stomach showed the latter to be fairly normal, although somewhat infected. Beneath the muscularis mucosa and replacing the submucosa and muscle was a mass of tumor which was growing in the form of large bundles and whorls of spindle-shaped cells. These frequently

Fig. 13 (Case 7).—Roentgenograms showing tumor in cardia of stomach.

had palisading nuclei and between the nuclear areas were zones of hyaline connective tissue. This had the appearance of a tumor derived from a nerve sheath. It appeared benign.

Diagnosis.—Diagnosis was ulcerated neurofibroma.

CASE 7 (A-129-311).—R. K., a 33-year-old woman, was admitted to the hospital because of a marked secondary anemia which was first noted during pregnancy. After delivery of a normal child, the anemia became more severe and it was then noted, for the first time, that the patient's stools were tarry. Epigastric distress, not relieved by food, had been a complaint throughout most of the pregnancy. On admission the hemoglobin was 40 per cent and there were 2,590,000 red cells per cubic millimeter of blood. Gastric analysis, after histamine, showed no free hydrochloric acid and a total acidity of 29 units. The gastric fluid contained blood. Roentgenogram (Fig. 13) showed a roughly oval polypoid tumor in the cardiac end of the stomach. At operation, Feb. 11, 1947, the tumor (Fig. 14) was removed by local resection. The postoperative course was uncomplicated.

Gross Pathology.—The specimen consisted of a tumor of the stomach 4 by 3½ by 3 cm., covered on one surface with mucous membrane with a small fringe of normal gastric mucosa around it. In the center of the mucosal surface there was an ulcerated area 4 mm. in diameter and 9 mm. deep. Cross section revealed the tumor to be composed of pale firm tissue, arising in the submucosal layer and elevating the mucosa. The tumor measured 2 cm. in its thickest portion.

Microscopic Examination.—Section (Fig. 15) showed some of the mucosa of the stomach, but underneath this and occupying the submucosa was a fairly cellular tumor which was probably derived from the nerve sheath. It was growing in the form of twisted bundles of rather plump spindle-shaped cells. The nuclei contained many fine transverse lines which alternated with the globules of mucinous material, thus giving to many of the nuclei the appearance of Schwann cells. Between them there were very delicate collagenous fibrils. The tumor was infiltrated with plasma cells and lymphocytes, but mitoses were absent or extremely infrequent.

Diagnosis.—Diagnosis was neurofibroma of the stomach.

CASE 8 (A-129-257).—G. S., a 61-year-old woman, was admitted to the hospital because of anemia and tarry stools. One year before admission she vomited a large amount of blood and passed tarry stools. Roentgenographic studies made at this time were said to be negative. Following this episode the patient remained well until one month prior to admission when she noted that the stools were again tarry. She had no real epigastric pain or distress at any time. Gastric analysis, after histamine, showed 67 units of free hydrochloric acid and a total acidity of 90 units. Roentgenogram (Fig. 16) showed an hourglass tumor of the cardiac end of the stomach. At operation, on Feb. 11, 1947, the tumor was found in the posterior wall of the cardiac end of the stomach and was removed by local excision. The postoperative course was uncomplicated.

Gross Pathology.—The specimen (Fig. 17) consisted of a portion of stomach, measuring 7 by 3 by 4 cm. and containing a tumor which apparently had arisen in the submucosal layer and extended out beyond the serosa forming a spherical, polypoid, encapsulated nodule which bulged outside the stomach wall. This pedunculated portion of the tumor measured 4 by 5 by 3 cm. Section showed the tumor to be composed of lobulated pale reddish tissue which extended through the serosa to form a cystlike structure filled with degenerated tissue and blood clot. The wall of this cystic portion was 3 mm. in thickness.

Microscopic Examination.—Section (Fig. 18) through the tumor showed a growth which was composed of closely packed plump cells which appeared to anastomose with each other, but did not possess any connective tissue fibrils. The nuclei tended to be rather short and plump and a few mitoses were found. In a few areas where there had been some hemorrhage, the nuclei were much larger than elsewhere, but were multinucleated. There was a moderate amount of palisading such as is seen in neurofibromas and leiomyomas. The Bielschowsky stain showed very little connective tissue in this tumor and the morphology suggested a tumor of the smooth muscle. It is possible that the growth was already malignant and the large nuclei were an indication of active growth.

Diagnosis.—Diagnosis was leiomyoma of the stomach, possibly malignant.

Fig. 14 (Case 7).—Neurofibroma of stomach with central ulceration.

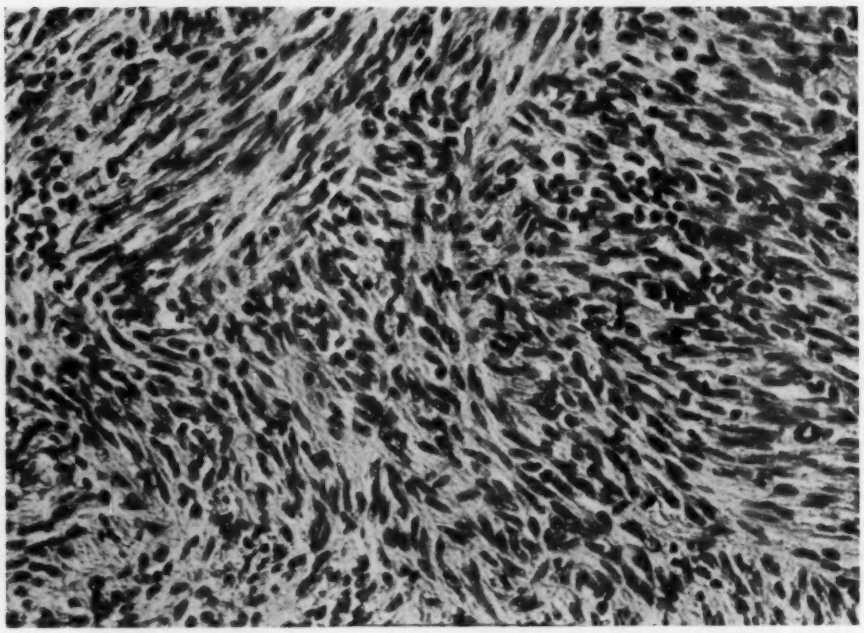

Fig. 15 (Case 7).—Section through tumor showing twisted bundles of rather plump spindle-shaped cells with palisading nuclei (×300).

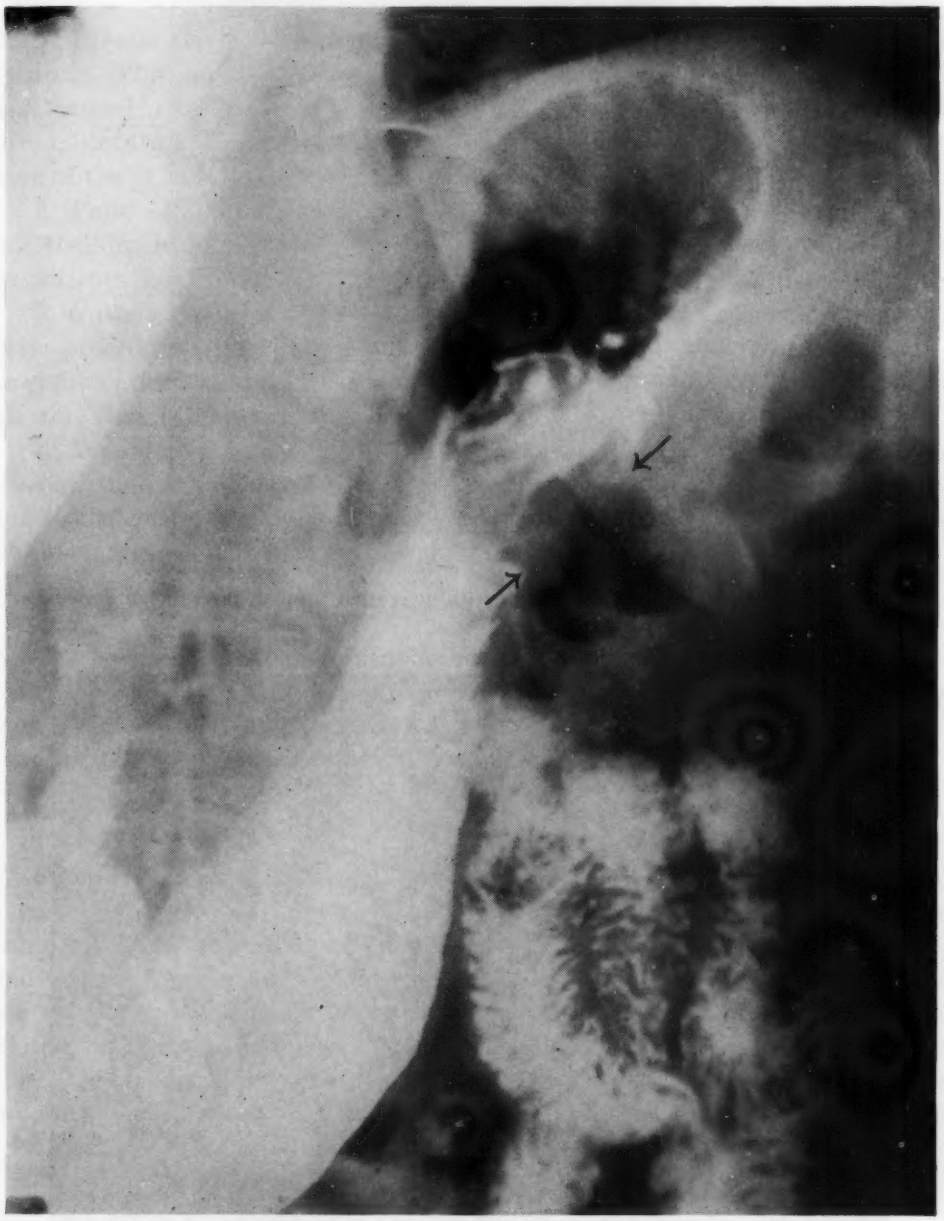

Fig. 16 (Case 8).—Roentgenograms showing an hourglass tumor of the cardia of the stomach.

Fig. 17 (Case 8).—Leiomyoma of stomach with ulceration through the overlying mucosa.

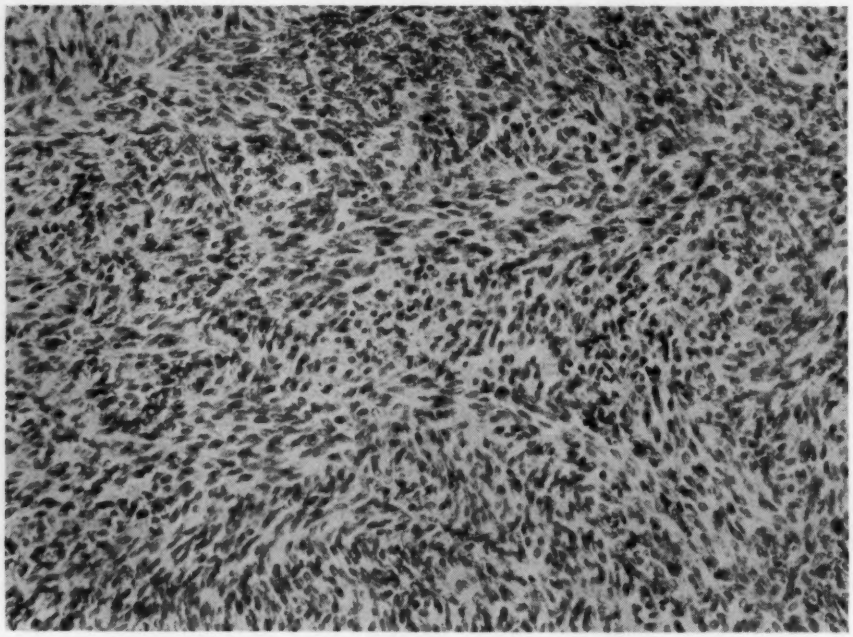

Fig. 18 (Case 8).—Section through tumor showing closely packed cells with a moderate amount of palisading and a few mitoses (×150).

DIAGNOSIS

The preoperative diagnosis of these tumors may be difficult but the following important features suggest a gastric tumor of smooth muscle or nerve sheath origin.

1. *Bleeding.*—The outstanding symptom in six of the eight patients was bleeding. This appeared to be caused by a central area of ulceration and in five cases caused a sudden severe hemorrhage. In one case the bleeding was of a chronic nature and the tumor was discovered when a search was made for the cause of the patient's secondary anemia.

2. *Pain.*—Pain was not a prominent symptom except in one man who had an active duodenal ulcer as well as tumor of the pyloric end of the stomach. All the patients, however, complained of a vague type of epigastric distress.

3. *Gastric Acidity.*—Gastric analysis was not of definite value as a diagnostic procedure. The gastric acidity, after histamine, was recorded for six of the eight patients. In two the acid values were high, in two they were low, and two were found to have normal gastric acidity.

4. *Roentgenograms.*—There was no constant diagnostic roentgen picture although the tumors usually appeared smooth in outline and often it was possible to demonstrate a central area of ulceration. A roentgen diagnosis of gastric tumor was made in seven of the eight patients.

MALIGNANT TRANSFORMATION

The possibility that these neoplasms may undergo malignant transformation is suggested by the fact that two of the eight tumors, on the basis of their microscopic appearance, were considered probably malignant. The symptoms and the gross appearance of the malignant tumors were essentially the same as those of the benign lesions.

TREATMENT

Four of the patients were treated by local excision of the tumor and four by gastric resection. There were no postoperative deaths. One patient with a benign tumor of the cardia was treated by resection of nine-tenths of the stomach. Nine months after operation this patient still has digestive complaints and has been unable to regain his preoperative weight. Because of this, and the magnitude of a gastric resection as compared with local excision, we feel that every effort should be made to determine the nature of the tumor at operation and that all benign tumors, at least those of the cardia, should be treated by local excision.

SUMMARY

1. Seven neurogenic and one smooth muscle tumor of the stomach are reported.

2. There is great similarity in the clinical features, the gross appearance, and the microscopic structure of the two types of tumors.

3. Bleeding was the chief symptom in six cases.

4. Two of the tumors appeared to have undergone malignant transformation.

5. Local excision appears to be adequate for the benign tumors.

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PRIMARY TUMORS OF THE JEJUNUM AND ILEUM

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PRIMARY tumors of the jejunum and ileum, though rare, are being recorded with increasing frequency. McDougal[1] stated that less than 300 cases of malignant disease have appeared in the literature up to 1944. Mayo and Nettrour[2] reported a total of 31 cases of carcinoma of the jejunum in patients seen at the Mayo Clinic prior to Feb. 1, 1937, of which only 15 could be subjected to resection and enteroenterostomy. Palliative enteroenterostomy or gastroenterostomy was carried out in 13, exploratory laparotomy in 2, and in 1 no surgical treatment was given. The operative mortality in this series was 20 per cent and the duration of life after operation 17.6 months. Shallow, Eger, and Carty[3] reported a series of 24 cases of primary malignant tumors of the jejunum and ileum encountered in the Jefferson Medical College Hospital. Of this number only 4 were found to be free of metastases. All of the jejunal lesions were resected and a primary anastomosis was performed. In the ileum 6 malignant tumors were resected with primary anastomoses; 1 lesion was exteriorized, and 3, which were not resectable, were given x-ray treatment. The operative mortality was 36 per cent and an analysis of the end results showed that 3 patients were living and well for periods of twelve, seven, and four years, respectively, after operation. Three others died of metastases after periods of fifteen, four, and three years, respectively. Fraser,[4] in presenting a series of 21 patients treated at the Western Infirmary in Glasgow, noted that 15 of this number were subjected to operation, resections being performed in 14. In the remaining patient a pelvic abscess was drained. The operative mortality was 60 per cent and of those who survived operation, none lived longer than nine years. One patient was alive three years; 3 patients, two and one-half years; and 1 patient one year after operation. Warren[5] reviewed 26 cases of malignant tumor of the small bowel from the Toronto General Hospital. Twenty-one of the tumors were situated in the jejunum or ileum. Of these patients one was well seventeen years, 1 patient eight years, and 1 patient 7 years after operation. Four patients were discharged improved, 3 died of metastases after approximately two years, 1 after one year, and 10 patients died in the hospital.

The rarity of these tumors is stressed by all authors. A review of our own experience and those of various other clinics indicates that the results of surgery compare unfavorably with those for malignancy of the large bowel. Although these tumors are manifested by a typical symptomatology, the establishment of the diagnosis is frequently delayed and a grave prognosis is the result.

Although a total of one-half million patients have been admitted to the New York Hospital since Sept. 1, 1932, the diagnosis of primary tumor of the jejunum and ileum has been histologically established in only 19 cases of which 12 were malignant and 7 benign. Of the latter group, 3 were incidental autopsy findings and were in no way related to the cause of death.

TABLE I. PRIMARY MALIGNANT TUMORS OF JEJUNUM AND ILEUM—PREOPERATIVE CLINICAL FINDINGS

Case number Name Hospital number	1 M. H. 53940	2 H. B. 197518	3 Z. B. 41932	4 L. M. 301544	5 O. M. 319274	6 J. F. 340543	7 A. A. 340797	8 R. H. 336343	9 F. W. 92595	10 J. F. 373632	11 H. R. 442280	12 S. E. 478686
Year admitted	1934	1938	1940	1941	1942	1942	1942	1942	1944	1945	1946	1947
Sex	M	M	F	M	M	M	F	M	M	F	F	M
Age (yr.)	34	42	48	44	44	50	47	52	38	62	49	36
Duration of symptoms (mo.)	6	1	12	6	4	1	12	60	8	8	12	24
Abdominal pain	+	+	+	+	+	+	+	+	+	+	+	0
Weight loss (pounds)	30	4	0	17	35	0	25	12	25	54	20	0
Vomiting	+	0	+	0	+	+	+	+	+	+	+	0
Constipation	+	+	0	0	+	0	+	+	+	0	+	0
Fatigue, weakness	+	+	+	+	+	+	+	+	+	+	+	+
Melena	+	0	0	0	0	0	0	+	+	+	0	+
Palpable abdominal mass	0	+	0	+	+	0	+	+	+	+	0	0
Occult blood in stool	+	+	0	+	0	+	0	+	0	+	+	+
R.B.C. (millions)	4.0	5.0	5.1	4.3	4.2	3.0	3.2	3.8	4.4	3.0	4.8	3.4
Hb. (Gm.)	12	13	14	12	10	6.5	9	11	14	8	13	8.5
Obstruction demonstrable by x-ray	+	+	+	+	0	+	+	0	+	0	+	+
Tumor demonstrable by x-ray	+	+	+	+	0	+	+	0	+	0	+	+

REPORT OF CASES

Primary Malignant Tumors

Age and Sex (Table I).—In this series of 12 cases, 8 were men and 4 women. The ages of the patients varied from 34 to 64 years, and the average for the group was 45.5 years. The women were slightly older than the men; their average age was 50.1 and that of the men, 42.5 years.

Symptoms (Table I).—The duration of symptoms before admission varied between one and sixty months, the average being 12.8 months. In all but one of the patients *pain* was present and usually this was the chief complaint. It was cramplike in nature in the majority of cases and was associated with varying degrees of obstruction. Not infrequently the pain, at the onset of the symptomatology, was mild and vague and was confused with the pain associated with cholecystitis or peptic ulcer. Its location was usually in the midepigastrium and the umbilical region. *Loss of weight* was a prominent symptom and only 3 patients gave no history of losing weight. The average loss in the others was 18.3 pounds and one man lost 54 pounds. *Vomiting* occurred in 9 patients. A marked degree of intestinal obstruction is the main factor in the production of vomiting, therefore, this symptom usually manifests itself late in the course of the disease. *Constipation* was recorded in 7 cases and a feeling of *fatigue* and *weakness* in all. A history of *melena*, as evidenced by tarry stools, was elicited from 6 patients.

Physical Signs (Table I).—A *palpable abdominal mass* was present in 7 of the 12 patients and some degree of *abdominal distention* associated with obstruction occurred in an equal number. One patient was admitted with symptoms and signs of *generalized peritonitis* and high obstruction of the small bowel (Case 3). *Pallor* and evidence of recent loss of weight were common findings.

Laboratory Tests (Table I).—*Anemia* was present in 8 of the 12 patients and *occult blood* in the stool was recorded in a like number. This test for blood in the feces is a very reliable aid and should be employed in all patients complaining of abdominal pain, whether cramplike or vague in nature. When there is no marked evidence of obstruction and after a period of careful observation, a roentgenologic examination should be made to ascertain whether a lesion is present. The passage of the barium as a split stream at the site of the lesion and narrowing of the lumen of the bowel are indicative of a tumor. The x-ray examination revealed a tumor in 9 of the cases. Varying degrees of obstruction, manifested by a widening of the lumen and consequent retention of barium proximal to the lesion were demonstrated in an equal number of cases.

Diagnosis.—The presence of a tumor of the small bowel can be established preoperatively by careful analysis of the symptoms, physical findings, laboratory tests, and roentgenologic examination. The history of intermittent intestinal obstruction manifested by cramplike abdominal pain and vomiting; the symptoms of anemia and presence of occult blood in the stools are highly suggestive. A small intestinal barium series establishes the diagnosis in a high percentage of cases. A careful exploration is indicated in all cases with the signs and symptoms just described. Cases 11 and 12 are examples of errors in diagnosis and are worthy of elaboration.

CASE REPORTS

CASE 11.—A 49-year-old woman entered the New York Hospital on July 5, 1946, with the history of abdominal pain of one year's duration, frequent vomiting, generalized weakness, malaise, chronic constipation, and loss of twenty pounds in weight. A cholecystectomy had been performed two months previous to this admission and the gall bladder was found to be chronically inflamed and contained gallstones. The patient's symptoms were unaltered by this procedure. Examination failed to reveal evidence of distention or a palpable mass. The stools were strongly positive for occult blood. A small intestinal barium series disclosed a tumor of the proximal jejunum, causing partial obstruction. Following adequate preparation, a laparotomy was performed on July 10, 1946, disclosing a stenosing adenocarcinoma of the jejunum, 10 cm. from the ligament of Treitz. A 16 cm. segment of jejunum, bearing the tumor, was resected and an enteroanastomosis was carried out. The patient had an uneventful recovery and has remained well to the present time.

CASE 12.—A 36-year-old man was admitted to the New York Hospital on June 13, 1947, with the history of fatigue and weakness for a period of two years. There were three admissions to another hospital—two in October, 1946, and the third in February, 1947, at which time a splenectomy was performed for presumed hemolytic anemia. Following this procedure the patient failed to improve and the blood picture remained unaltered. At the time of admission to the New York Hospital there was no history of abdominal pain, vomiting, or loss of weight. The red blood cell count was 3.4 million and the hemoglobin 8.5 Gm. The stools were strongly positive for occult blood and a small intestinal barium series showed a tumor in the proximal jejunum with slight obstruction. An exploratory laparotomy, performed on June 30, 1947, disclosed an adenocarcinoma in the proximal jejunum with extensive involvement of mesenteric lymph nodes. Resection and anastomosis were performed but there were metastases which could not be removed. The patient now feels well and the anemia has cleared.

Comment.—These two cases are examples of errors in preoperative and operative diagnosis. In both instances the initial operators apparently failed to examine the small bowel in the region of the duodenojejunal junction. Thorough exploration would have avoided the errors.

Treatment (Table II).—Resection and enteroanastomosis were performed in 8 cases out of the 12 and exploratory laparotomy in 3. One patient was not subjected to operation as there was evidence of widespread metastases and ascites. Examination of the ascitic fluid removed by paracentesis disclosed lymphoid tumor cells. This patient received intensive x-ray therapy but died six weeks after admission.

The procedure of choice is resection of the segment of bowel bearing the lesion with a wide margin of mesentery and the restoration of the continuity of the intestinal lumen by aseptic end-to-end anastomosis performed over clamps. The discrepancy between the diameters of the dilated proximal and the normal distal transected intestine can be readily corrected by placing the clamp obliquely on the latter. In the 8 patients who underwent this procedure there was no postoperative death and only one complication, a wound infection in a patient who was admitted with generalized peritonitis secondary to a perforated leiomyosarcoma of the jejunum (Case 3).

Before any operative procedure is attempted, it is essential to correct the anemia, the plasma protein deficiency, and any other fluid or electrolyte imbalance. The obstructed bowel should be decompressed by applying continuous suction to a Miller-Abbott or Levine tube.

Roentgen therapy is of no value in the postoperative management of carcinomas of the small bowel, but should be employed when the diagnosis of lymphosarcoma has been established, whether the lesion is resectable or not. Radiation therapy was used in Cases 1, 2, 4, and 8. It was also employed in the one case of carcinoid of the jejunum with extensive metastases (Case 5).

Pathology (Table II).—The tumor was situated in the jejunum in 10 and in the ileum in 2 cases, the proximal jejunum being the commonest location. Six of the lesions were adenocarcinomas, 4 lymphosarcomas, 1 a leiomyosarcoma which had perforated, and 1 a carcinoid with widespread metastases. No metastatic involvement could be demonstrated in 5 of the cases, either at operation or in the resected specimen. Of this group, one patient ultimately died of a recurrent lesion and metastases (Case 3). Intussusception was present in 2 cases.

Prognosis (Table II).—The long period of delay before a diagnosis is established results in a poor prognosis. Of the 12 patients, 5 are now living. One (Case 1) is well thirteen years following resection of multiple lymphosarcomas of the jejunum. Four (Cases 6, 7, 11, and 12) are living following resection of the jejunum for adenocarcinoma; 2 for five years, 1 for fifteen months, and 1 for three months. The latter 2 patients had metastases which could not be removed. Seven patients have died; one not subjected to operation died in the hospital of widespread metastases from a jejunal lymphosarcoma. Of the remaining 6, one died six years and seven months after resection of the jejunum for a perforated leiomyosarcoma; one lived sixteen months after exploration which disclosed a jejunal carcinoid with metastasis. Two patients (Cases 9 and 10) died eighteen and seventeen months, respectively, after resection of the jejunum for adenocarcinoma with metastases, while the remaining two died eight and four months, respectively, after exploratory laparotomy which revealed inoperable lymphosarcoma of the ileum.

Benign Tumors

The small intestine may harbor a variety of benign tumors although these are extremely rare. A review of the literature and our own cases show that lesions include leiomyomas, fibromas, submucous lipomas, lymphangiomas, hemangiomas, polyps, and carcinoids. In our series there were only 7 cases of which 3 were incidental autopsy findings apparently unrelated to the cause of death, as clinical findings referable to the tumor were not recorded in the case histories (Table III). Four of the 7 lesions were leiomyomas, 1 a lipoma, 1 a fibroma, and 1a polyp (Tables III and IV).

Four patients were admitted to the New York Hospital with symptomatic benign tumors of the jejunum. The duration of symptoms varied from three days to fifteen months and there was an equal sex incidence. An analysis of the clinical findings shows that the prevailing symptoms are similar to those of the malignant lesions and that the differentiation can only be made by the operating surgeon and the pathologist. Obstructive symptoms, melena, weakness, and loss of weight are common findings. Examination failed to disclose an abdominal mass in any of the cases. Severe intestinal hemorrhage and anemia were present in 2 patients. In 3 of the cases a roentgen examination revealed evidence of small intestinal obstruction or the presence of a tumor (Table III).

TABLE II. PRIMARY MALIGNANT TUMORS OF JEJUNUM AND ILEUM

CASE NUMBER	DATE OF OPERATION	OPERATIVE FINDINGS	OPERATIVE PROCEDURE	SURGICAL PATHOLOGY	COMPLICATIONS	OPERATIVE RESULT	X-RAY THERAPY	FOLLOW-UP
1	2/12/34	Multiple stenosing lesions of jejunum, obstruction	Resection of 42 cm. of jejunum; lateral anastomosis	Multiple lymphosarcoma of jejunum; no metastases	None	Improved	Yes	Living and well 13 yr.
2	None						Yes	Died 6 weeks after admission; autopsy verified lymphosarcoma of jejunum with widespread metastases
3	10/ 4/40	Perforated tumor of lower jejunum; obstruction; peritonitis	Resection of 10 cm. of jejunum; end-to-end anastomosis	Leiomyosarcoma of jejunum; no metastases	Wound infection	Improved	None	Apparently well for 5 yr.; died of metastases, after 6 yr. and 7 mo.
4	7/ 7/41	Inoperable tumor of ileum; extensive metastases	Exploratory laparotomy	Lymphosarcoma	None	Unimproved	Yes	Lived 8 mo.
5	1/23/42	Inoperable tumor mass; metastases	Exploratory laparotomy and biopsy	Carcinoid of jejunum with metastasis	None	Unimproved	Yes	Lived 16 mo.
6	10/28/42	Tumor proximal jejunum; obstruction, intussusception, no metastases	Resection of 22 cm. of jejunum; end-to-end anastomosis	Mucus adenocarcinoma of jejunum	None	Improved		Living 5 yr.; well to the present time

7	10/24/42	Tumor proximal jejunum; obstruction, intussusception, no metastases	Resection of 26 cm. jejunum; end-to-end anastomosis	Mucous adenocarcinoma of jejunum; no metastases	None	Improved	Yes	Living 5 yr.; well to the present time
8	12/15/42	Inoperable tumor of ileum with partial obstruction	Exploratory laparotomy	Lymphosarcoma of ileum	None	Unimproved	Yes	Lived 4 mo.
9	8/31/44	Tumor lower jejunum; obstruction, metastases	Resection of 25 cm. of jejunum; end-to-end anastomosis	Adenocarcinoma of jejunum with metastases	None	Improved	None	Lived 17 mo.
10	9/15/45	Tumor proximal jejunum; obstruction, metastases	Resection of 14 cm. of jejunum; end-to-end anastomosis	Adenocarcinoma of jejunum with metastases	None	Improved	None	Lived 18 mo.
11	7/10/46	Tumor proximal jejunum, obstruction; no metastases	Resection of 16 cm. of jejunum; end-to-end anastomosis	Adenocarcinoma of jejunum	None	Improved	None	Well 15 mo.
12	6/30/47	Tumor proximal jejunum; metastases	Resection of 20 cm. of jejunum; end-to-end anastomosis	Adenocarcinoma of jejunum with metastases	None	Improved	None	Patient felt well 3 mo. after operation

TABLE III. BENIGN TUMORS OF JEJUNUM AND ILEUM—CLINICAL FINDINGS

CASE NUMBER	1	2	3	4	5	6	7
Name	L. B.	G. B.	S. H.	W. S.	C. Y.	B. D.	C. B.
Hospital number	22831	215560	439722	117668	70263	178306	277887
Year admitted	1940	1941	1946	1947	1934	1937	1940
Sex	M	F	F	M	M	M	F
Age (yr.)	47	2½	38	52	54	3 days	62
Duration of symptoms	15 mo.	10 days	2 mo.	3 days			
Abdominal pain	0	+	+	+			
Weight loss (pounds)	20	?	10	0	Incidental autopsy finding; diagnosis, polypoid fibroma of jejunum	Incidental autopsy finding; diagnosis, submucous polyp of ileum	Incidental autopsy finding; leiomyoma of jejunum
Vomiting	0	+	0	+			
Constipation	0	+	+	+			
Fatigue, weakness	+	+	+	0			
Melena	+	0	+	0			
Palpable mass	0	0	0	0			
Occult blood in stools	+	0	+	0			
R.B.C. (millions)	3.0	4.5	2.1	4.2			
Hb. (Gm.)	7.8	13.	6	14.2			
Obstruction demonstrable by x-ray	0	+	0	+			
Tumor demonstrable by x-ray	0	0	+	0			

TABLE IV. BENIGN TUMORS OF THE JEJUNUM AND ILEUM

CASE NUMBER	PATIENT	DATE OF OPERATION	OPERATIVE FINDINGS	OPERATIVE PROCEDURE	SURGICAL PATHOLOGY	COMPLICATIONS	RESULT	FOLLOW-UP
1	L. B.	6/21/40	Tumor mass, proximal jejunum	Resection of 7 cm. jejunum; end-to-end anastomosis	Leiomyoma	None	Cured	Well since operation
2	G. B.	5/10/41	Tumor mass, jejunum; obstruction adhesions	Resection 20 cm. jejunum; side-to-side anastomosis	Leiomyoma	None	Cured	Well since operation
3	S. M.	4/10/46	Tumor mass proximal jejunum; intussusception, obstruction	Resection 17 cm. jejunum; end-to-end anastomosis	Pedunculated leiomyoma	None	Cured	Well since operation
4	W. S.	4/22/47	Tumor mass, midjejunum; obstruction, intussusception	Resection 10 cm. jejunum; end-to-end anastomosis	Submucous lipoma	None	Cured	Well since operation

Exploratory laparotomy was performed on the 4 patients admitted to the hospital with symptoms and the lesion was resected in all four. Restoration of the continuity of the bowel was accomplished by aseptic end-to-end anastomosis in 3 and side-to-side anastomosis in 1 case (Table IV). Intussusception was present in 2 cases and varying degrees of obstruction in 3 cases. The operative procedures were accomplished without complications and there were no deaths. Follow-up studies show that all patients have been completely well since operation.

SUMMARY AND CONCLUSIONS

1. The clinical findings of 19 cases of tumor of the jejunum and ileum are presented.

2. Of the 12 patients with malignant lesions, 11 were subjected to operation. Resection of the tumor with enteroanastomosis was carried out in 8 instances without a death.

3. Of the 8 patients with resectable malignant lesions, 5 still survive: 1 over thirteen years, 2 over five years, 1 less than two years, and 1 less than one year.

4. Resection of the jejunum was performed in 4 patients with benign tumor of the jejunum without complication or mortality.

5. The poor prognosis in malignant lesions of the small bowel is the result of the long interval between the onset of symptoms and surgical intervention.

6. A history of intermittent intestinal obstruction and melena and the presence of occult blood in the stool are of great diagnostic significance. The small intestinal barium series will establish the diagnosis in a high percentage of cases.

7. The importance of careful exploration, in the presence of the symptoms and signs referred to, is stressed.

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PENETRATING WOUND OF THE CHEST WITH DIVISION OF A BRONCHIAL ARTERY

Report of a Case

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WOUNDS involving the bronchial arteries with recovery apparently are rare. A review of the literature for the past twenty-eight years has failed to reveal a reported case. In the case here reported, recovery followed the division of the left bronchial artery by a shell fragment of unusual size.

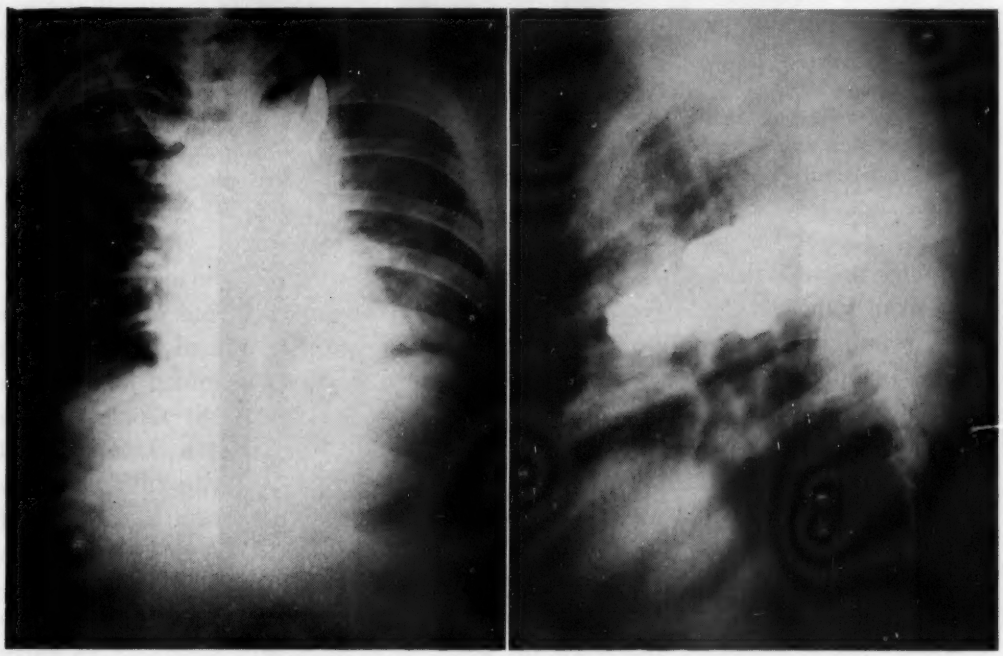
Ordinarily there are three bronchial arteries, two on one side and one on the other. Two arteries on the right side and one on the left are found as commonly as the classical description of two arteries on the left side and one on the right.[1] When there are two bronchial arteries on one side, both usually take their origin from the front of the aorta, one below the other at or near the level of the fourth thoracic vertebra. A single bronchial artery on one side may arise either as a common trunk with the upper bronchial artery of the opposite side or from the first aortic intercostal artery. Occasionally bronchial arteries may arise from the internal mammary, inferior thyroid, or subclavian arteries. Hovelacque, Monod, and Evrard,[1] and Nakamura[2] have investigated the great variability of the origin and course of the bronchial arteries. In the case being reported, a left bronchial artery arose from the lateral surface of the aorta, passing directly to the posterior surface of the left bronchus.

CASE REPORT

A 28-year-old officer was admitted to an evacuation hospital, Jan. 14, 1945, two hours after being wounded in the left posterior part of the chest by a shell fragment. He showed no evidence of shock, the pulse rate being 90, and the blood pressure 128/84. Removal of the dressing revealed a wound 6 cm. long and 3 cm. wide, medial to the scapula. There was no obvious sucking or hemorrhage. Roentgenograms (Figs. 1 and 2) showed a large foreign body penetrating the left side of the chest in a posteroanterior direction, through the fifth costal interspace.

Ninety minutes after admission, nitrous oxide-ether anesthesia under positive pressure was begun. After suitable cleansing and preparation, the wound was gently explored. The outer end of the foreign body was palpated 2.5 cm. below the level of the skin, and strong pulsations synchronous with the heartbeats were transmitted through it. The foreign body was tightly wedged between the badly comminuted fifth and sixth ribs and was not manipulated for fear of starting an intrathoracic hemorrhage. A posterior thoracotomy incision was made through the eighth interspace on the left. The posteroinferior border of the upper lobe of the left lung was lacerated along its entire length with the inner end of the foreign body lodged against the lateral surface of the aorta. Five hundred cubic centimeters of clotted blood were removed from the pleural cavity, and the shell fragment was dislodged and withdrawn from its wedged position between the ribs. This was followed by profuse arterial bleeding. Digital pressure against the hilus of the lung close to the aorta controlled the bleeding but not before a loss of approximately 1,500 c.c. of blood had occurred. Replacement with cross-matched stored blood was started.

After removal of the blood by suction, the pressure was gradually released, revealing the spurting stump of what was determined to be a bronchial artery. The artery was clamped and doubly ligated with silk 1.5 cm. from its aortic origin. Its diameter was between 3 and 4 mm. No other arteries arising from the aorta and passing to the lung were noted in this area. The pleura covering the posterior surface of the hilus had been



Figs. 1 and 2.—Roentgenograms, Jan. 14, 1945, showing huge size and position of shell fragment before removal.

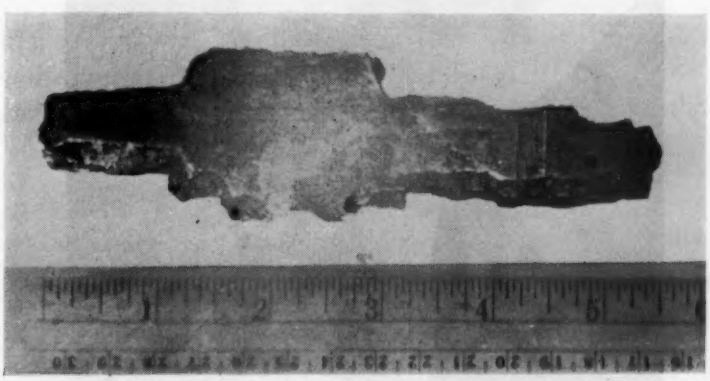


Fig. 3.—Shell fragment with scale in centimeters and inches.

lacerated so extensively by the missile that the entire width of the main bronchus close to the aorta and the inferior pulmonary vein were exposed. The badly damaged lung tissue was resected and the lung closed with mattress sutures of silk. Thirty-five thousand units of penicillin and 7 Gm. of sulfanilamide were placed in the pleural cavity and the thoracotomy incision was closed in layers with interrupted silk sutures. The wound of entrance was débrided, the ends of the fractured ribs resected, and the wound sutured. The patient's condition remained good throughout the procedure.

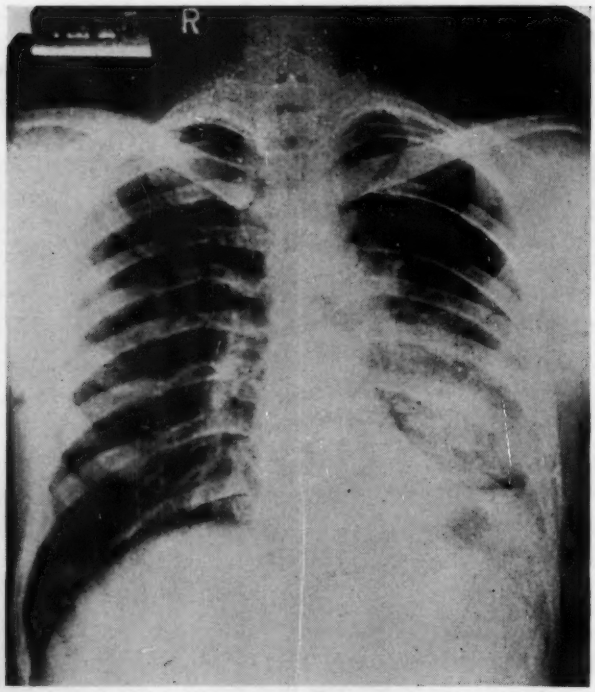


Fig. 4.—Roentgenogram, March 8, 1945, showing condition of chest approximately seven weeks after operation.

Fig. 5.—Patient, March 8, 1945. The upper scar shows the site of entry of the fragment; the surgical approach is indicated by the lower scar.

The postoperative course was uneventful. For several days there was a cough productive of small amounts of old dark blood. On the second day 700 c.c. of serosanguineous fluid were aspirated from the left pleural cavity. On the fourth day aspiration was repeated and 200 c.c. of fluid were removed. Forty thousand units of penicillin were given intramuscularly every four hours for forty-eight hours, and 1 Gm. of sulfadiazine was given by mouth every four hours for seven days. This patient made satisfactory progress toward recovery and was evacuated to a general hospital on the seventh postoperative day.

Subsequent reports from a general hospital and from the patient over a period of eight months indicated that a satisfactory recovery was made. The patient stated by letter that there was a "lag" of the left chest during respiration and that he has had breathlessness on moderate physical exertion. He felt well however, was able to engage in such sports as golf, swimming, and dancing, and had been returned to limited duty.

COMMENT

No evidence of necrotic change in the lung of this patient occurred. The source of the blood supply to the bronchi and lung substance may have been from another bronchial artery not seen posteriorly or, as rarely happens, from a bronchial artery passing along the anterior surface of the bronchus. It seems more probable that the blood supply was obtained through anastomoses between the bronchial arterial system above the point of division and other arteries. All recent investigators agree on the presence of a capillary anastomosis between the bronchial and pulmonary arteries, but deny the existence of a precapillary anastomosis.[3-6] An injection method in the living dog has shown the existence of gross anastomoses between the bronchial, internal mammary, intercostal, and esophageal arteries.[7] Injections of human autopsy specimens have demonstrated gross extracardiac anastomoses between the auricular branches of the coronary arteries and the bronchial arteries.[8]

SUMMARY

1. An unusual case, a wound of the chest with division of a bronchial artery, is reported.

2. A satisfactory recovery followed ligation of the artery without evidence of gangrene of the bronchi or lung substance.

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RESECTION OF THE RECTUM WITH PRESERVATION OF THE ANAL SPHINCTER

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IN THE past few years increasing attention has been devoted to methods by which malignant tumors of the rectosigmoid and rectum might be extirpated without sacrifice of the normal mechanism of defecation. There has been the question in the minds of many surgeons whether it were not possible to avoid the creation of a permanent abdominal colostomy and at the same time perform a resection of the tumor-bearing tissues sufficiently radical as not to compromise the patient's chance for survival. The question is a highly controversial one, and the answer can come only through the accumulation of a sufficiently large volume of cases performed by the two methods to allow comparative studies. In view of this, it seems worth while to review a series of cases in which resection of the rectum was carried out by the perineal route or by the combined abdominal and perineal routes, the anal sphincters being preserved to allow voluntary control of defecation. The present series, while not large, is presented for the purpose of supplementing existing and future series of similar cases with a view toward assessing the proper value of such procedures.

HISTORICAL

The technique utilized in this series is by no means new, nor is the idea of preserving the sphincters new. In an excellent article published in 1945, Bacon[1] reviewed "the evolution of sphincter muscle preservation and re-establishment of continuity in the operative treatment of sigmoidal and rectal cancer." Mandl[2] also, in a recent article, reviewed the history of such procedures, while reviewing his experiences with the Hochenegg[3] "pull-through" operation. It was the latter who, near the end of the nineteenth century, evolved the technique of resecting the growth-bearing segment of rectum, and invaginating the proximal divided end of sigmoid through the anus, with or without stripping of the anal mucosa.

This procedure, with slight modifications, was also performed by a number of other surgeons in the late nineteenth and early twentieth centuries.

Since 1932 Babcock[4] and his colleague Bacon[5] have been enthusiastic proponents of a procedure based upon the Hochenegg maneuver, but having an important modification. These surgeons mobilize the sigmoid and upper rectum through the abdomen, after ligation of the superior hemorrhoidal vessels, and then proceed to resect the rectum from below, leaving the external sphincter intact.

Other authors in the past few years have advocated transabdominal resection with end-to-end anastomosis. Dixon[6] in 1944 found a three-year survival

rate of 58 per cent in a series of 104 patients on whom he had performed this procedure for carcinoma of the rectosigmoid. Wangensteen[7] reported that he resected the ampulla of the rectum in twenty-seven patients, using the Hochenegg procedure in some, and end-to-end anastomosis in others. Waugh and Custer[8] likewise have found it possible to perform end-to-end anastomosis through the abdomen after resection of lesions very low in the rectum.

A different approach is that recently proposed by Murray[9] who utilized the transsacral approach in performing resection with end-to-end anastomosis. He resects the fourth and fifth sacral segments and has carried out this procedure on fifteen patients with one permanent fecal fistula and perfect continence in all other cases.

Mahorner[10] reported a combined procedure, carried out on five patients. He mobilizes the bowel through an abdominal incision, then turns the patient over and resects the lesion through an oblique incision over the perirectal fossa, performing an end-to-end suture.

MATERIAL

The present study comprises a review of sixty-eight patients operated upon on the Surgical Service of New York Hospital between September, 1932, and December, 1946. The operations were performed by Dr. Heuer, or his associates, or his residents: approximately fifteen different surgeons. Follow-up studies are based upon examinations carried out in the Follow-up Clinic of the Surgical Service, where each patient was seen at intervals of six months. In only four cases was the evaluation based upon a letter or telephone conversation.

The pathologic diagnoses made on the surgical specimens were as follows: adenocarcinoma (not graded) fifty-nine; polypoid carcinoma three; adenoma malignum three; scirrhous carcinoma, carcinoma simplex, and metaplastic adenoma, one each.

OPERATIVE TECHNIQUE

The operation as performed at present is carried out as follows: through a left rectus incision the abdomen is explored. This permits the operator to assess the factors which enable him to determine whether or not preservation of the sphincter muscles is advisable.

The sigmoid is mobilized by incising the parietal peritoneum on either side of the bowel down to the reflexion of the peritoneum. The mesentery of the sigmoid is then clamped and ligated below the superior hemorrhoidal artery. We do not hesitate to divide the superior hemorrhoidal artery if its integrity prevents sufficient mobilization of the sigmoid to bring it down to the perineum. The rectum is mobilized in the hollow of the sacrum posteriorly and from the bladder anteriorly. The dissection is carried as far downward beneath the peritoneal reflexion as is possible through the abdominal incision which is then covered with several laparotomy pads. Two assistants remain at the abdominal field to complete the surgery there.

The patient is then placed in lithotomy position with the foot of the table slightly elevated, and the perineum is prepared and draped. The operator and one assistant then proceed with the perineal part of the operation.

A circular incision is made at the mucocutaneous junction around the anus and is carried vertically downward over the coccyx and lower end of the sacrum. The anus is readily dissected free from the sphincter muscles. A purse string

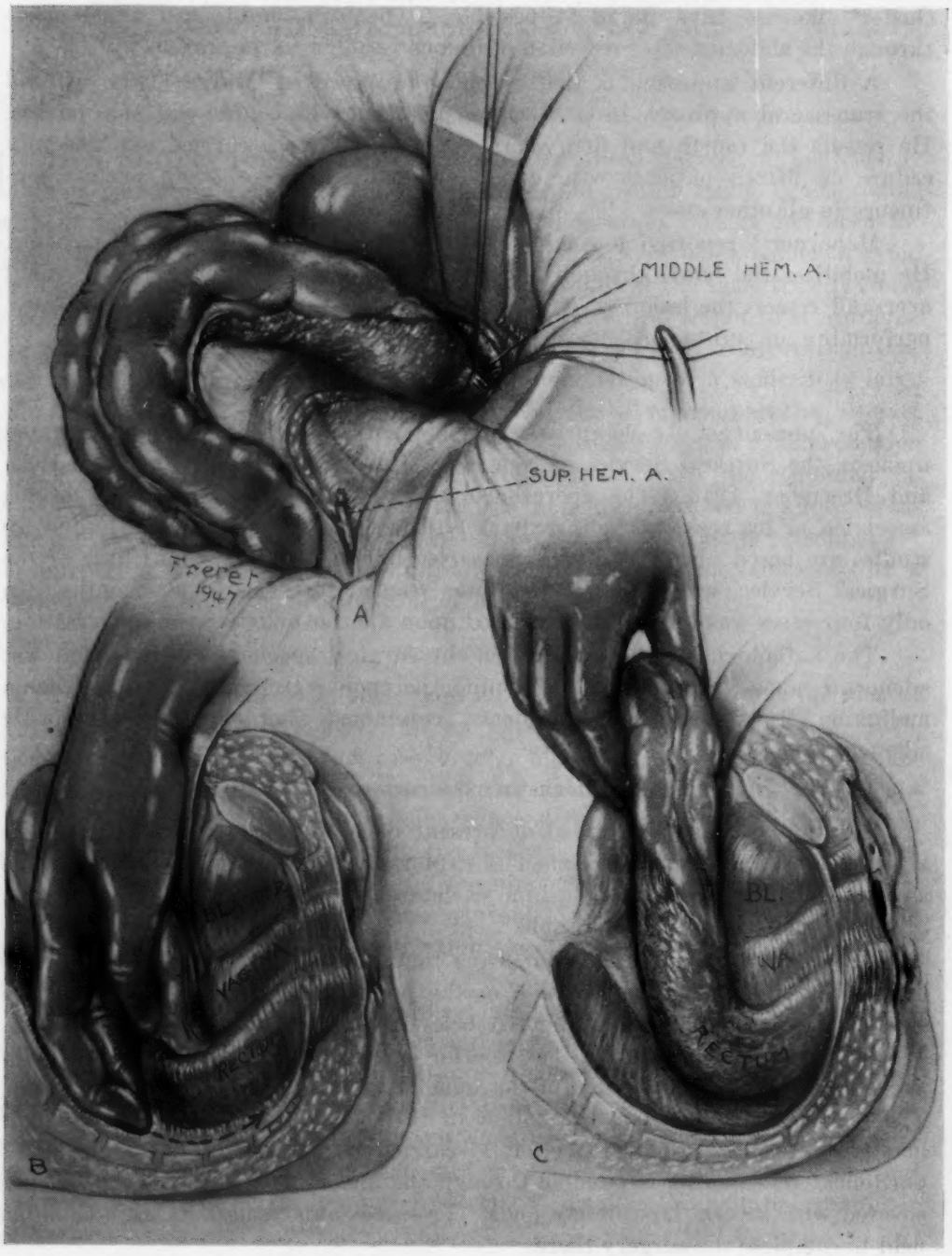

Fig. 1.—*A*, *B*, and *C* illustrate the abdominal portion of the operative procedure demonstrating the mobilization of the sigmoid.

of braided silk is used to occlude the anus and for traction on the rectum. The sphincter ani muscles are encircled by two silk ligatures on either side of the median raphe posteriorly and are then divided between the ligatures. These are left in place to identify the severed ends when the plastic repair is performed at the close of the procedure.

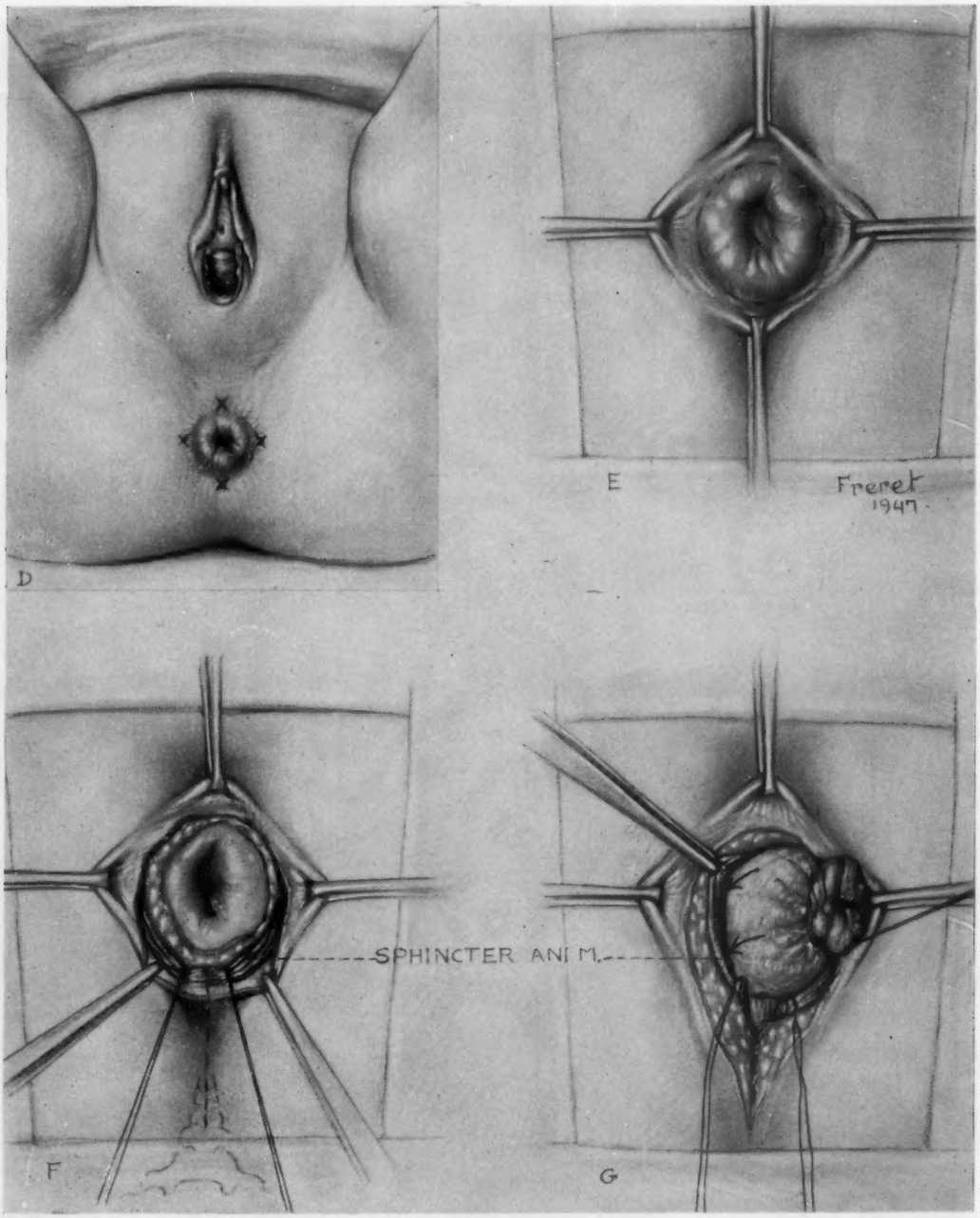

Fig. 2.—*D, E, F* and *G* illustrate the mobilization of the rectum with preservation of the sphincter ani muscles (see Fig. 3).

The vertical incision is deepened through the subcutaneous tissues. The coccygeal ligaments are divided, and if the coccyx interferes with the dissection, it is removed. Mobilization of the rectum is then carried upward until the levator ani muscles are encountered. These are divided as far laterally as the operator believes necessary. The rectum is separated from the prostate and

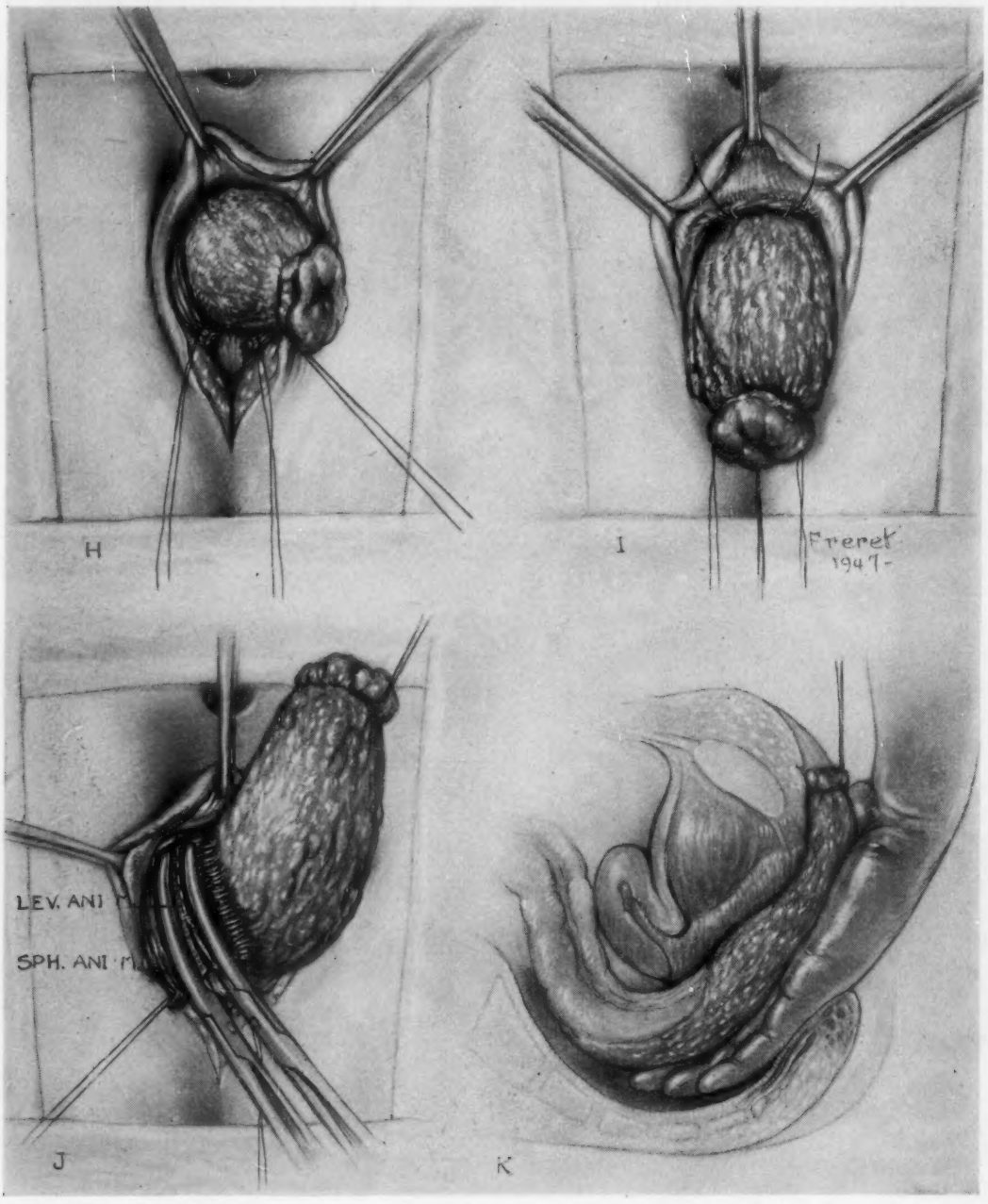

Fig. 3.—*H, I, J,* and *K* illustrate the mobilization of the rectum with preservation of the sphincter ani muscles (see Fig. 2).

seminal vesicles or vagina by blunt and sharp dissection. At this point the rectum may usually be delivered through the wound without difficulty and the sigmoid drawn down to the anal sphincters.

If sufficient tissue remains, the levator ani muscles are reapproximated to the wall of the sigmoid, as we believe that they aid in control of defecation. The ends of the divided sphincter muscles are identified by the previously

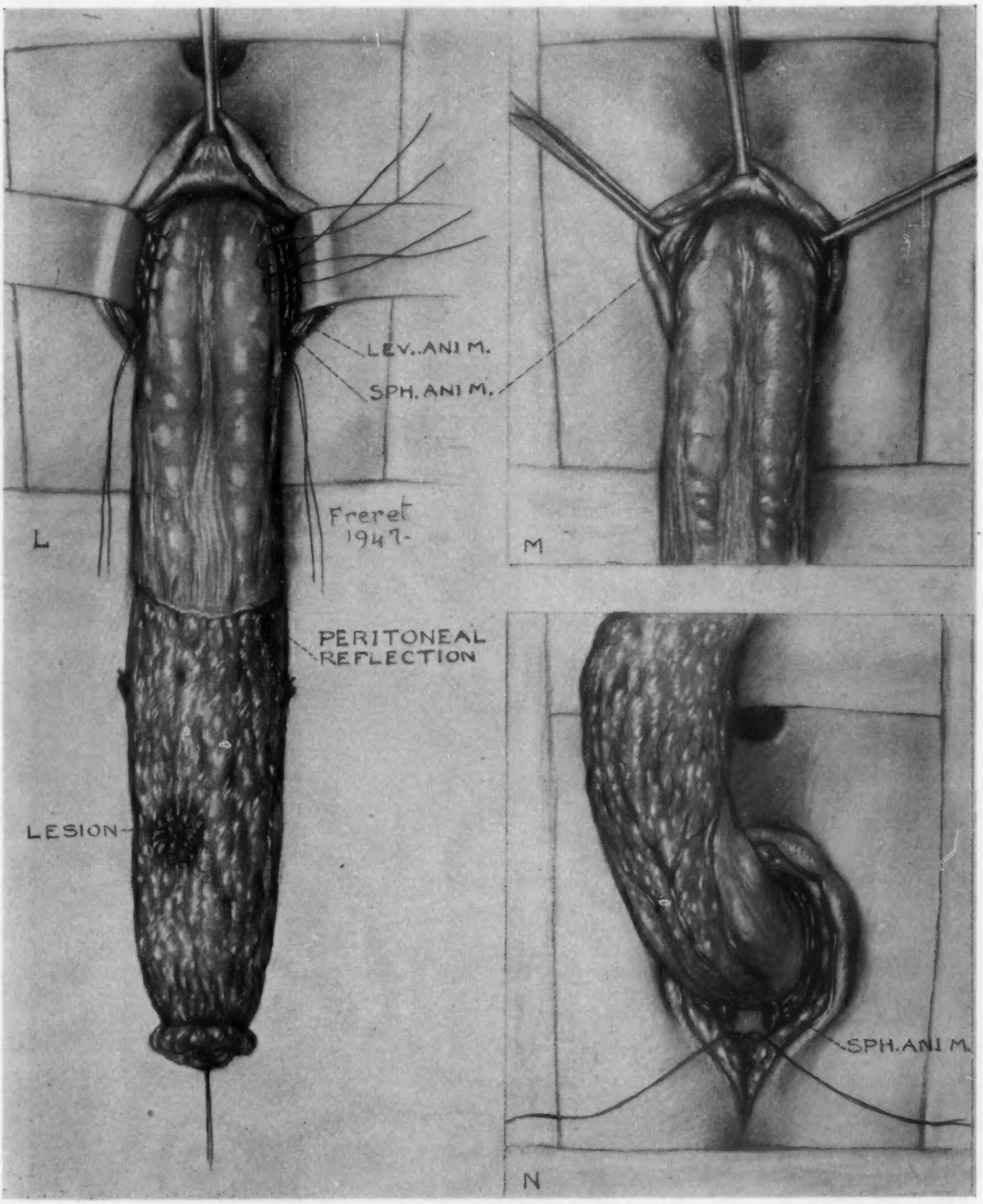

Fig. 4.—*L*, *M*, and *N* illustrate the plastic reconstruction of the anus (see Fig. 5).

placed silk sutures and are reapproximated around the sigmoid. One or two cigarette drains are then placed into the pelvis posterior to the bowel wall. The sigmoid is sutured to the anal skin margin and the vertical incision closed. The final step in the perineal part of the procedure is excision of the bowel flush with the skin. When it has been ascertained that the sigmoid safely reaches the anal sphincters, the two assistants at the abdominal field complete the repair of the peritoneum around the sigmoid and close the abdominal wound.

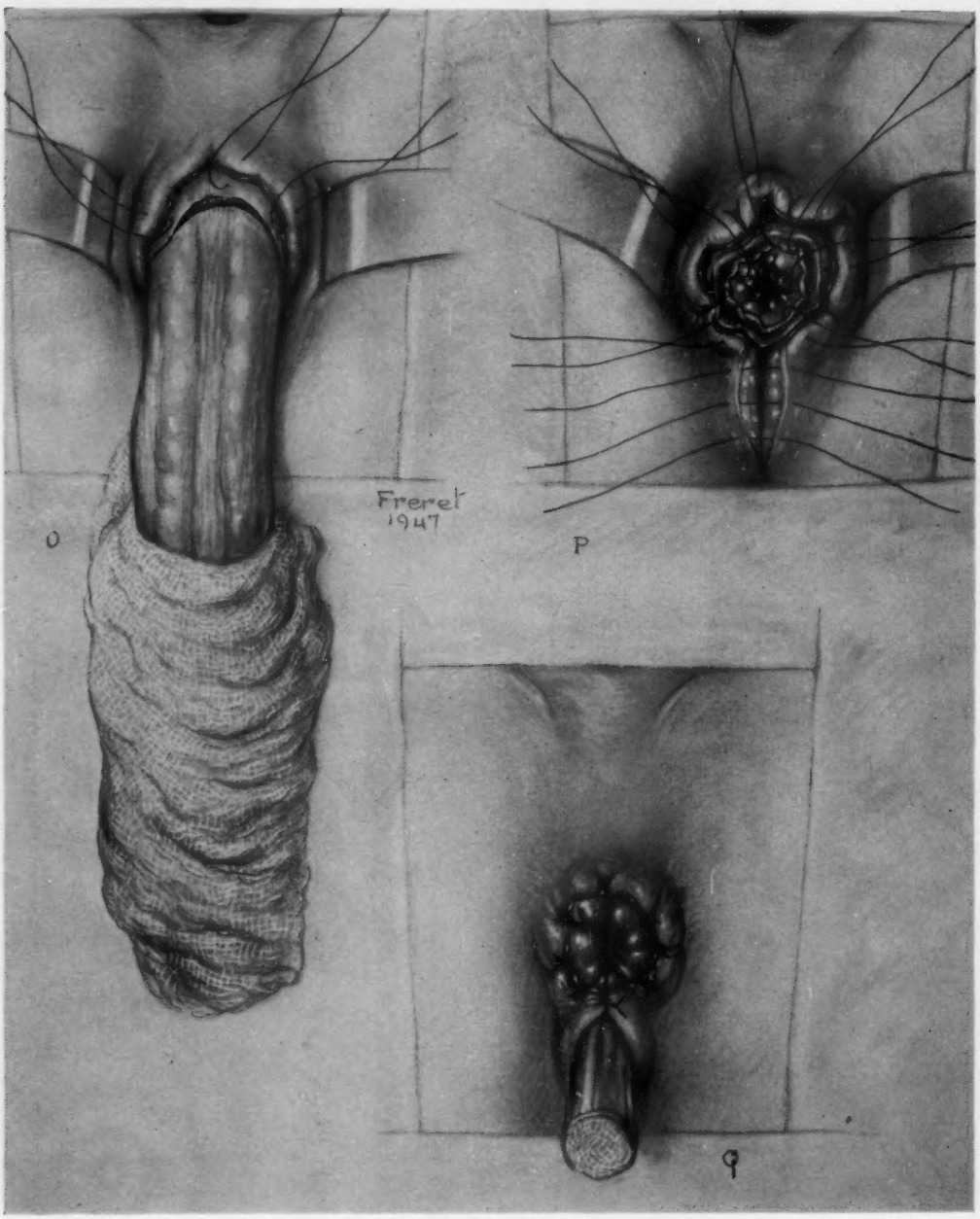

Fig. 5.—*O* and *P* illustrate the plastic reconstruction of the anus (see Fig. 4). *Q* represents the final appearance of the anus.

MORTALITY

Of sixty-eight patients operated upon, nine died in the hospital, yielding a postoperative mortality rate of 13.2 per cent. This figure, when compared to other figures published in recent years, seems excessive. For this reason it is of interest to inquire further into the deaths and to subdivide them according to years (Table I). It is significant to note that all deaths occurred prior to 1941, and that there were no deaths in the group of twenty-three patients operated upon between 1941 and 1946.

TABLE I. MORTALITY BY YEARS

YEAR	NUMBER OF CASES	NUMBER OF DEATHS
1932	3	0
1933	5	0
1934	9	4
1935	4	0
1936	2	0
1937	3	0
1938	8	2
1939	10	2
1940	4	1
1941	7	0
1942	3	0
1943	3	0
1944	4	0
1945	0	0
1946	3	0
Total 15 Years	68	9

It is of further interest to observe the causes of death and the ages of the patients (Table II). One death, that of a 39-year-old patient, should have been prevented; another patient of 50 years should not have been subjected to operation, inasmuch as he was found to have pulmonary metastases. All the others were patients in the seventh decade or older.

TABLE II. PATIENTS DYING POSTOPERATIVELY

HISTORY NO.	NAME	SEX	AGE (YR.)	CAUSE OF DEATH
22511	R. G.	F	64	Peritonitis
58822	M. G.	F	67	Gas gangrene in perineal wound
65688	J. R.	F	62	Purulent phlebitis and septicemia
69997	H. T.	M	73	Pneumonia and infarcts
79801	P. M.	M	64	Multiple abscesses, abdominal wall, buttocks
211143	L. G.	F	66	Pulmonary embolus
227038*	A. W.	M	50	Bronchopneumonia superimposed on pulmonary metastatic cancer
270596	L. F.	F	39	Hemorrhage and shock
194158	S. B.	M	74	Suicide

*This case was wrongly diagnosed as bilateral bronchiectasis prior to operation. The patient died of bronchopneumonia. At autopsy metastatic cancer of the lungs was found, obviously not a suitable case for operation.

The decline in the mortality rate reflects the improvements in preoperative preparation, methods of anesthesia, and postoperative care of surgical patients. Furthermore, our experience has run closely parallel to that of Lehman and Becker[11] who, in reviewing all surgical deaths at the University of Virginia

TABLE III

YEARS OF SURVIVAL	NUMBER OF PATIENTS UNDER CONSIDERATION	NUMBER OF PATIENTS SURVIVING	SURVIVAL RATE (%)
3	61	38	62
5	55	22	40
10	23	6	26

Hospital, found a progressive decline from 7.1 per cent in 1934, to 3.5 per cent in 1940, to 2.5 per cent in 1946. To be more specific in regard to patients in this group, there can be no doubt that increased attention to nutritional requirements, especially proteins and vitamins, is an important factor in the decline. The advent of the sulfonamide drugs and penicillin played a part, as well as an appreciation of the importance of thorough mechanical cleansing of the gastrointestinal tract before operation.

SURVIVAL RATES

In computing the survival rates in this series, we base our figures on the results in sixty-one patients, since seven patients were operated upon after 1943, or less than three years before this study was undertaken. We have, of course, not excluded the nine patients who died in the immediate postoperative period. There was a three-year survival rate of 62 per cent, a five-year rate of 40 per cent, and a ten-year rate of 26 per cent (Table III).

TABLE IV. SURVIVAL STATISTICS

YEARS OF SURVIVAL	NUMBER OF PATIENTS	PRESENT STATUS
15	1	Living without evidence of recurrence
14	1	
12	1	
11	1	
10	2	
9	1	Living without evidence of recurrence but lost to follow-up since October, 1944
8	3	1 living without evidence of recurrence 1 living with recurrence when last seen in May, 1946 1 died of metastases in 1946
7	2	1 living without recurrence 1 living with recurrence, April, 1946
6	4	3 living without recurrence, one last seen in August, 1945 1 now dead
5	6	4 no evidence of recurrence 2 now dead
4	7	All dead
3	9	6 dead 3 living without evidence of recurrence; 1 last seen in June, 1944
2	2	Both dead
1	5	All dead
Less than 1 year	7*	All dead
Postoperative death	9	
Total 61		

*Includes two patients who had purely palliative procedures.

These figures are to be compared with those recently published by Bacon, based upon records of eighty-one patients operated upon three or more years before his study. He found a three-year survival rate of 58.6 per cent and a five-year rate of 50 per cent.

Table III may be further broken down and presented in a more comprehensive form as shown in Table IV.

FUNCTIONAL RESULTS

It would be futile to go to great lengths to preserve the anal sphincters if, after their preservation, they failed to function. We have, therefore, investigated closely the functional results in this group of patients. It should be pointed out again that evaluation is based, in all except four cases, upon direct questioning and examination of the patients. We have, perhaps, been rather too strict in our assessment of these results in a sincere desire to judge for ourselves the efficacy of this technique.

Of 68 patients subjected to this procedure, 9 died in the immediate postoperative period; 10 patients either died within 1 year of operation or have been operated less than 1 year before and so are not suitable for evaluation; 5 patients developed recurrence within one year and were subjected to colostomy.

Since no information as to function is available on nine patients, there remain thirty-four cases suitable for evaluation from the standpoint of function of the reconstructed anal outlet. Results have been evaluated as follows: (1) Perfect: indicating normal control regardless of consistency of stools, no staining, and the presence of a sphincter which on examination contracts normally; (2) good: indicating control of bowels with no soilage except under unusual circumstances, such as an episode of diarrhea or following the use of a laxative —a few patients in this group have rather tight strictures, two requiring occasional dilatation; (3) fair: these patients must wear a perineal pad at all times because of unpredictable accidents; they have control of the bulk of the stool but there is a slight leak or staining on frequent occasions; for this reason they are insecure without a pad; (4) poor: in this category are carried those patients who have no control of the stools, no sphincter, and who have what amounts to a perineal colostomy.

As judged by these standards the results are: perfect, 3; good, 7; fair, 10; poor, 14; making a total of 34.

Admittedly this is a small series of patients (thirty-four) from which to draw conclusions as to function. Some value, however, stems from the fact that each has been critically examined and no evaluation made without sound basis.

DISCUSSION

In the light of our present knowledge, then, is there justification for a procedure such as this?

Lahey and Miles, to name only two of the opponents of sphincter-preservation operations, firmly believe that there is no place for such a procedure in the attack upon cancer. They base their arguments upon the assumption that

no procedure in which the sphincters are preserved can be sufficiently radical. Miles, furthermore, stated that carcinoma of the rectum has three zones of spread: upward, downward, and laterally. Recent careful investigations concerning the spread of cancer of the rectum have been made by Coller, Kay, and MacIntyre,[12] by Gilchrist and David,[13] and by Glover and Waugh.[14] The findings of these several investigators are fairly uniform, and while they do not directly contradict the statements of Miles, they do serve to modify the meaning of the three zones of spread. The conclusions of these authors indicate that the primary zone of spread is upward, to the nodes of the mesosigmoid; that lesions whose lower border is 2 cm. or more above the insertion of the levator muscles do not tend to spread laterally, and that retrograde spread takes place only to a distance of 3 cm. below the lower margin of the growth, except in rare instances.

If we can assume, as a result of the findings of these investigators, that extension does not, in general, occur laterally along the levators or downward toward the skin and sphincters, there remains only the question of whether it is possible to secure a resection sufficiently high to remove involved nodes in the mesosigmoid. Certainly this cannot be accomplished entirely from below. Whether or not it can be accomplished by a combined abdominal and perineal approach is determined by several variables: (a) length and "redundancy" of sigmoid; (b) distribution of blood vessels; and (c) depth of pelvis.

It is possible, by mobilizing the decending colon and splenic flexure to provide sufficient length of colon to reach the perineum through a pelvis of any depth, provided the blood vessels do not restrict the transplantation. It has been found, contrary to earlier opinion, that it is possible to divide the superior hemorrhoidal artery and the lowest sigmoidal branch of the inferior mesenteric artery without consequent necrosis of the lower end of the sigmoid. On the other hand, in some cases even after division of these vessels the sigmoidal arcades are so short as to prevent descent of the sigmoid sufficiently far into the pelvis. These factors, therefore, can be judged only at the operating table with the abdomen open.

This procedure has a limited field of application. Our belief, based upon our experience with this series and the investigations of others, is that it is applicable only to lesions whose lower margin is at least 6 cm. above the anal orifice, and whose upper limit is at or below the peritoneal reflection. When cases are restricted within this field, favorable results may be expected. If, however, enthusiasm for the procedure influences one to stretch the indications, the value of the operation becomes lost. As to the functional results, it was noted that in fourteen patients the attempt to provide sphincteric control was a failure; possibly these patients would have been better off with an abdominal colostomy. On the other hand, all of the remaining twenty patients, even those required to wear a perineal pad, are probably better equipped to pursue their daily activities than are others with abdominal colostomies.

In conclusion, then, we believe that if cases are properly selected, the operation of abdominoperineal resection can be carried out and the anal sphincters preserved without jeopardizing the patient's chance of survival, and with a good chance of providing him with a functioning anal outlet.

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RADICAL ONE-STAGE PANCREATICODUODENECTOMY

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DURING the twelve years which have elapsed since Allen O. Whipple and his associates[1] announced their initial success in extirpating the duodenum and the head of the pancreas, the original two-stage operation has undergone many modifications. Although the story of the development of what might be termed the present-day radical operation is a fascinating one, it has been covered adequately elsewhere and reiteration at this time does not seem particularly profitable. Because, however, numerous of the details in the operation continue to be the subject of debate, it still seems in order to report even a relatively small series of cases in which one general method of completing the operation has been rather rigidly observed. It is the purpose of this report, therefore, to review an operation which has proved satisfactory in a group of twenty-two patients operated upon at the New York Hospital during the past six years.

In November, 1943, I[2a] reported a one-stage procedure which was justly criticized by Whipple not only because drainage of the biliary tract was re-established by means of the gall bladder, but also because this anastomosis was placed distal to that between the stomach and the jejunum. The operation was promptly changed to one in which biliary drainage was obtained by way of a choledochojejunostomy placed proximal to the gastroenterostomy. In all of these cases save five a Coffey[3] type of end-to-end pancreaticojejunostomy was performed.[2b]

In this series of twenty-two consecutive radical pancreaticoduodenectomies the operation was performed by six different surgeons, three of whom were surgical residents. For purposes of convenience these cases have been outlined in Table I. The postoperative mortality was 27 per cent.

In the course of acquiring experience with the technique of this one-stage procedure, it was found helpful to have clearly in mind a series of steps which, if followed in orderly progression, contribute materially to shortening and facilitating a procedure which is always long and arduous.

1. The abdominal cavity is entered through an upper transverse incision. Although several of these cases were operated upon quite satisfactorily through the right rectus incision, it seemed that the transverse position offered the most satisfactory exposure, particularly if the dissection needed to be carried far out on the tail of the pancreas.

2. After entering the peritoneal cavity a preliminary search is made for distant metastasis which if found constitutes a contraindication to any further procedure other than a palliative cholecystenterostomy.

TABLE I. RADICAL ONE-STAGE PANCREATICODUODENECTOMY
(NEW YORK HOSPITAL, 1941-1947)

CASE NO.	INITIALS	AGE (YR.)	HIST. NO.	PRIMARY CARCINOMA	DATE OF OPERATION	PANCREATICO-JEJUNOSTOMY	RESULT
1	A. C.	62	451310	Ampulla	8/ 6/46	No	I & D Intraperitoneal abscess 8/30/46; now well 14 mo.
2	S. H.	55	363096	Ampulla	12/20/43	Yes	Dead; metastases 14 mo.
3	G. T.	46	409149	Ampulla	3/31/45	Yes	Well 2 yr., 7 mo.
4	E. M.	67	436554	Ampulla	2/27/46	No	P.O. death 13th day; pancreatic fistula, anuria
5	A. F.	46	464078	Ampulla	1/ 9/47	Yes	P.O. death 14th day; anuria
6	B. T.	65	471549	Islet cell	3/14/47	Yes	P.O. death 1st day; adm. blood sugar 19 mg. per 100 c.c.
7	J. C.	55	49256	Pancreas	4/28/41	No	P.O. death 15th day
8	S. M.	58	445401	Pancreas	5/21/46	Yes	Dead 11 mo.; presumed recurrence
9	R. F.	11	408141	Pancreas	10/ 1/46	Yes	Dead 5 mo.; recurrence
10	H. G.	54	459407	Pancreas	11/ 1/46	Yes	Well 11 mo.
11	C. F.	59	145716	Pancreas	11/ 8/46	Yes	P.O. death 30th day; spontaneous pneumothorax
12	E. F.	46	460622	Pancreas	11/12/46	Yes	Alive 12 mo.; recurrence
13	E. M. S.	62	429937	Pancreas	2/11/47	Yes	Well 6 mo.
14	N. C.	70	472383	Pancreas	4/ 1/47	No	P.O. death 5th day; division of superior mesenteric vein
15	B. M.	74	107557	Pancreas	1/23/47	Yes	Alive 10 mo.; (?) recurrence
16	M. M.	69	Memorial Hosp.	Pancreas	12/14/46	Yes	Alive 8 mo.; lost to follow-up
17	J. B.	57	311583	Duodenum	11/28/41	Yes	Dead 18 mo.; recurrence
18	W. M.	69	361219	Duodenum	7/ 3/43	Yes	Well 4 yr., 3 mo.
19	C. K.	53	380758	Duodenum	4/ 4/44	Yes	Well 3 yr., 6 mo.
20	A. O.	66	439925	Duodenum	4/11/46	No	Well 1 yr., 6 mo.
21	W. H. J. M.	65	375553	Stomach	1/ 6/44	Yes	Well 17 mo.; died, "stroke"
22	J. F.	49	273642	Ascending colon	2/25/47	Yes	Well 8 mo.

3. Attention is then directed to the common duct, the pancreas, and the duodenum. At this point the problem of the differential diagnosis between common duct stone, chronic pancreatitis, carcinoma of the pancreas, and primary tumors of the ampulla of Vater and duodenum arises. This may be extremely simple, as would be the case in promptly producing a large common duct stone, or tremendously complex, as in a patient harboring a small carcinoma little more than 1 cm. in diameter buried deeply in the head of the pancreas. Many surgeons have attempted to elucidate this difficult problem without, as yet, any simple answer becoming evident. Suffice it to state that fortunately, or unfortunately, the ease with which a positive diagnosis is made still must rest with the surgeon's skill as a gross pathologist. Yet a decision must be made. Cattell[4] has probably made the most helpful single suggestion, namely, that if

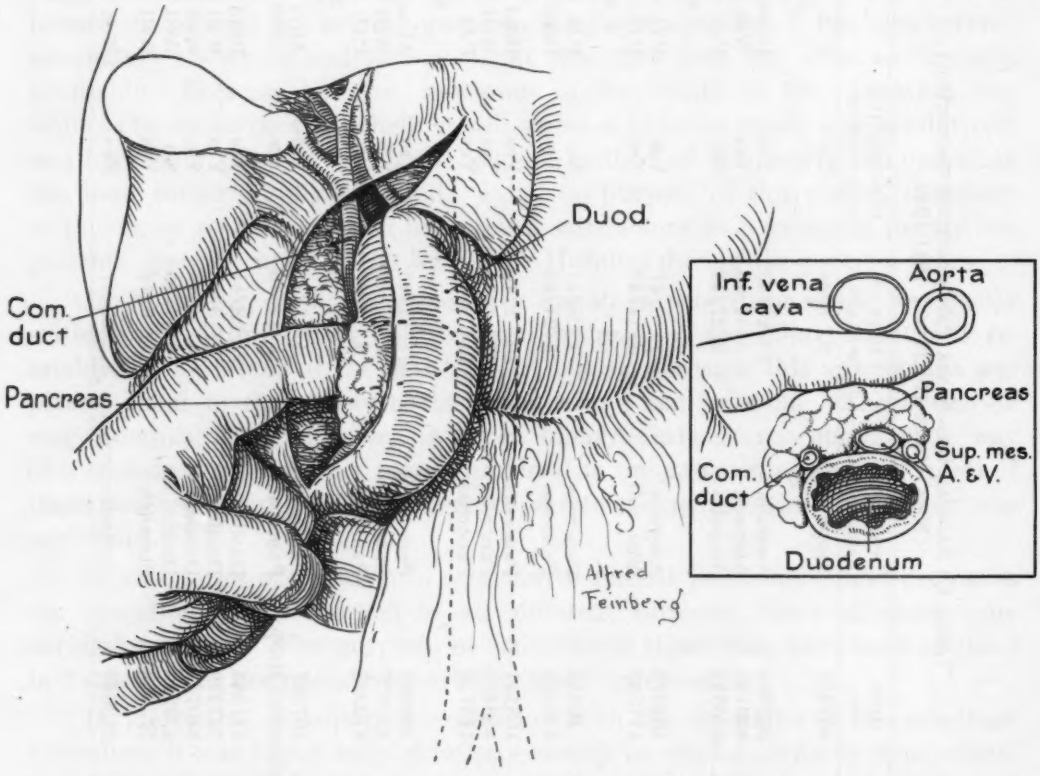

Fig. 1.—By dividing the peritoneal reflection over the duodenum as far caudad as possible, the loose areolar space between the pancreas and the deeper structures may be entered readily. At this point the presence or absence of periaortic nodes involved in metastatic cancer may be determined. If such lymphatic involvement or direct extension is identified the procedure should be abandoned at this stage.

the presence of cancer cannot with reasonable certainty be proved, a two-stage procedure should be accepted as the maneuver of choice at this time. After subsidence of the jaundice, re-exploration may then indicate whether or not a perplexing pancreatic enlargement is carcinomatous or inflammatory. If, however, there is reasonable assurance that a malignant tumor is present, the operator is justified in proceeding, with the realization that the majority of pancreatic cancers have been removed without benefit of a positive microscopic diagnosis.

At this point it might be well to note that as yet there is no complete agreement as to whether or not enlarged regional lymph nodes constitute an absolute contraindication to progressing with an otherwise operable neoplasm. It is my opinion that as long as these tumors technically permit extirpation the patient should not be denied his only chance of cure because of the presence of a few enlarged lymph nodes.

4. Having elected to proceed, the next step involves division of the right paraduodenal peritoneum from the orifice of the foramen of Winslow as far caudad as possible (Fig. 1). By careful digital dissection behind the duodenum and uncinate process of the pancreas, valid information may be obtained with regard to direct extension of the tumor to the aorta, and by palpation just beyond the tip of the uncinate process some indication may be obtained as to whether the superior mesenteric vein is grossly invaded. Should these maneuvers prove encouraging, the duodenum may be replaced and attention directed toward the next step.

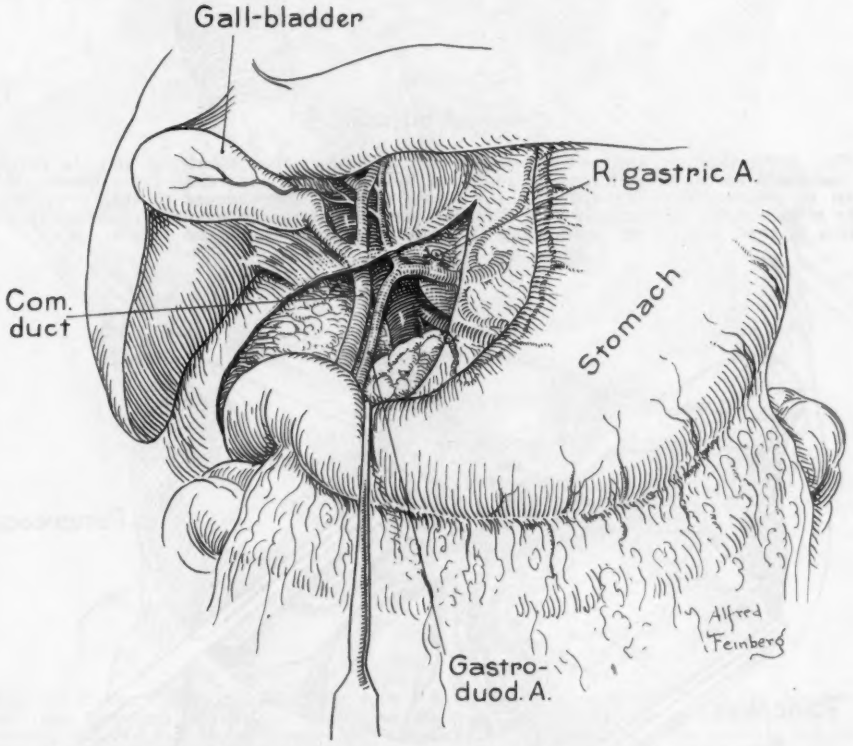

Fig. 2.—Division of the right gastric artery, the lower gastrohepatic ligament, and upper portion of the peritoneal reflection of the duodenum provides excellent exposure of the portal vein and superior aspect of the pancreas. Since many of the pancreaticoduodenal tumors tend to extend early to this area the question of operability may occasionally be decided by this exposure alone.

5. This step involves division of the right gastric artery and adjacent gastrohepatic ligament, exposing the cephalic aspect of the pancreas and ventral aspect of the superior mesenteric vein as it fuses with the splenic vein to become the portal vessel. Cautiously these structures are identified and digitally explored, again for evidences of direct invasion of the superior mesenteric vein by tumor (Fig. 2).

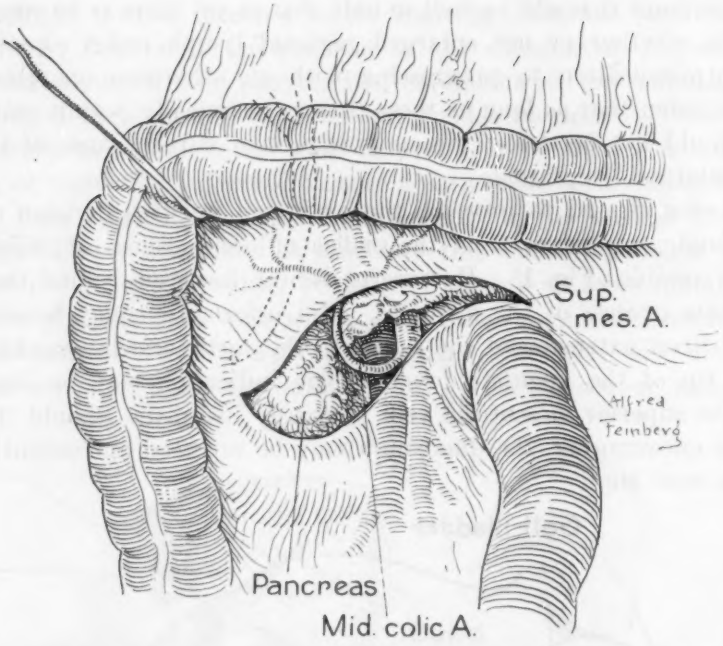

Fig. 3.—Indication as to whether or not the superior mesenteric vein is involved by direct extension of the cancer may be obtained by exploring this vessel from below. Although this can be accomplished by entering the lesser omental sac, access to this area can sometimes be more readily accomplished by dividing the base of the mesocolon transversely. Careful dissection is then helpful in delineating the inferior extension of the tumor.

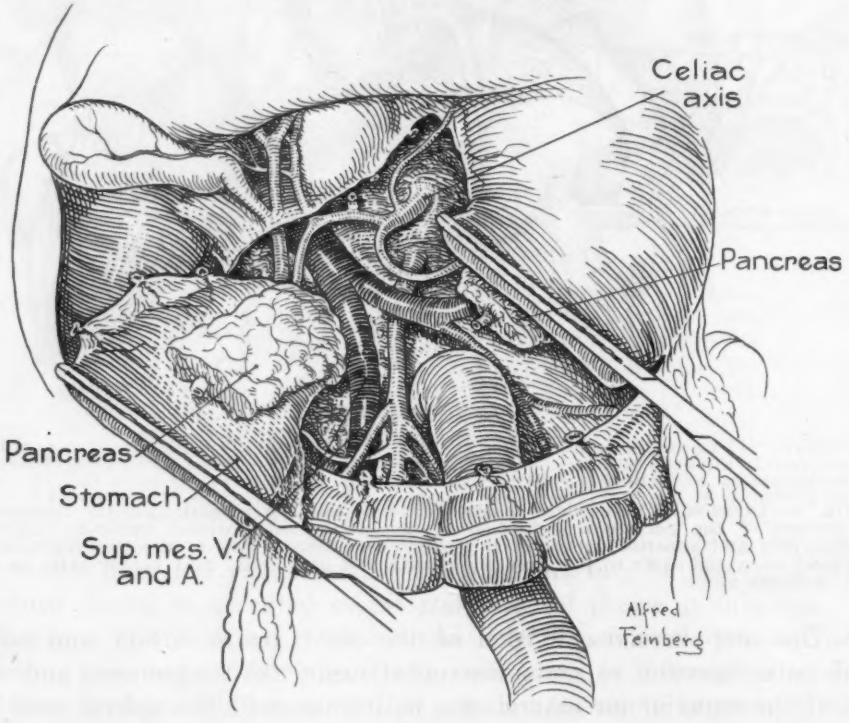

Fig 4.—Should the preceding three maneuvers have indicated that the tumor is operable, the first definitive step in resection must be taken, namely, division of the stomach and pancreas. This is accomplished at about the level of the midportion of the stomach. Dissection is then carried toward the right side of the patient, exposing the superior mesenteric vein as it lies in the groove made by the head and uncinate process of the pancreas.

6. The next step involves further investigation of the superior mesenteric vein, this time from below. This can be accomplished through the lesser omental sac, but it has seemed easier and more productive of useful information to explore the emergence of this vein from behind the pancreas by way of the mesocolon. The colon is therefore delivered into the wound and the base of the mesocolon incised transversely. Identification of the middle colic artery is relatively simple, and beyond this the border of the pancreas (Fig. 3). By palpating behind the pancreas with the right index finger above and the left below, it

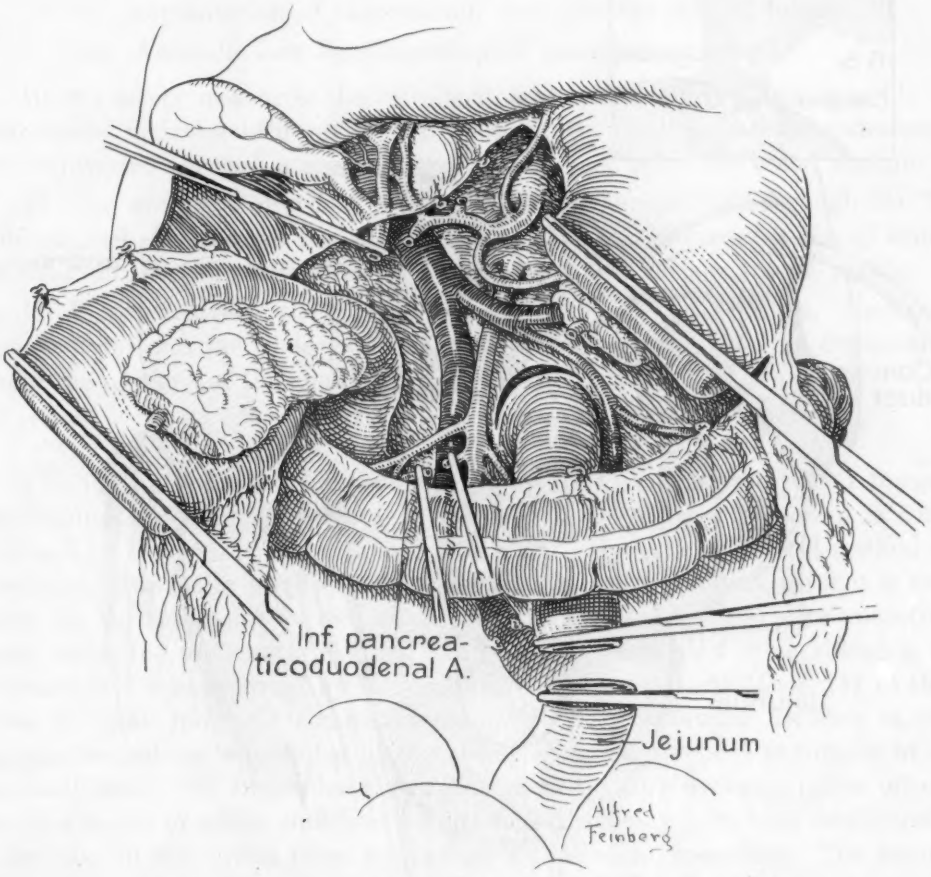

Fig. 5.—If the superior mesenteric vein can be freed successfully from the pancreas and its tumor, the resection is then completed by dividing the inferior pancreaticoduodenal artery, the jejunum, and the various structures constituting Treitz ligament. This permits the terminal duodenum and proximal jejunum to be delivered easily into the upper abdomen.

is possible to acquire reasonably accurate information as to whether or not the inaccessible middle third of the retropancreatic segment of the superior mesenteric vein is comprised by actively infiltrating neoplasm. If the operator feels unhesitatingly as a result of these two last steps that this vein, the *bete noire* of pancreatectomy, is invaded by tumor, the procedure may be readily abandoned; if there is indication that it is uninvolved, the first definitive step in the resection may be taken.

7. This step involves dividing the stomach at its mid-portion and, in the same vertical plane, traversing the pancreas, temporarily ligating the pancreatic duct. Dissection is then swept closely along the liver and splenic artery, including all the regional lymphatic beds. The specimen is allowed to fall inferiorly and to the left. As the lesser omental sac is skirted inferiorly, the immediately adjacent segments of greater omentum may be conveniently re-

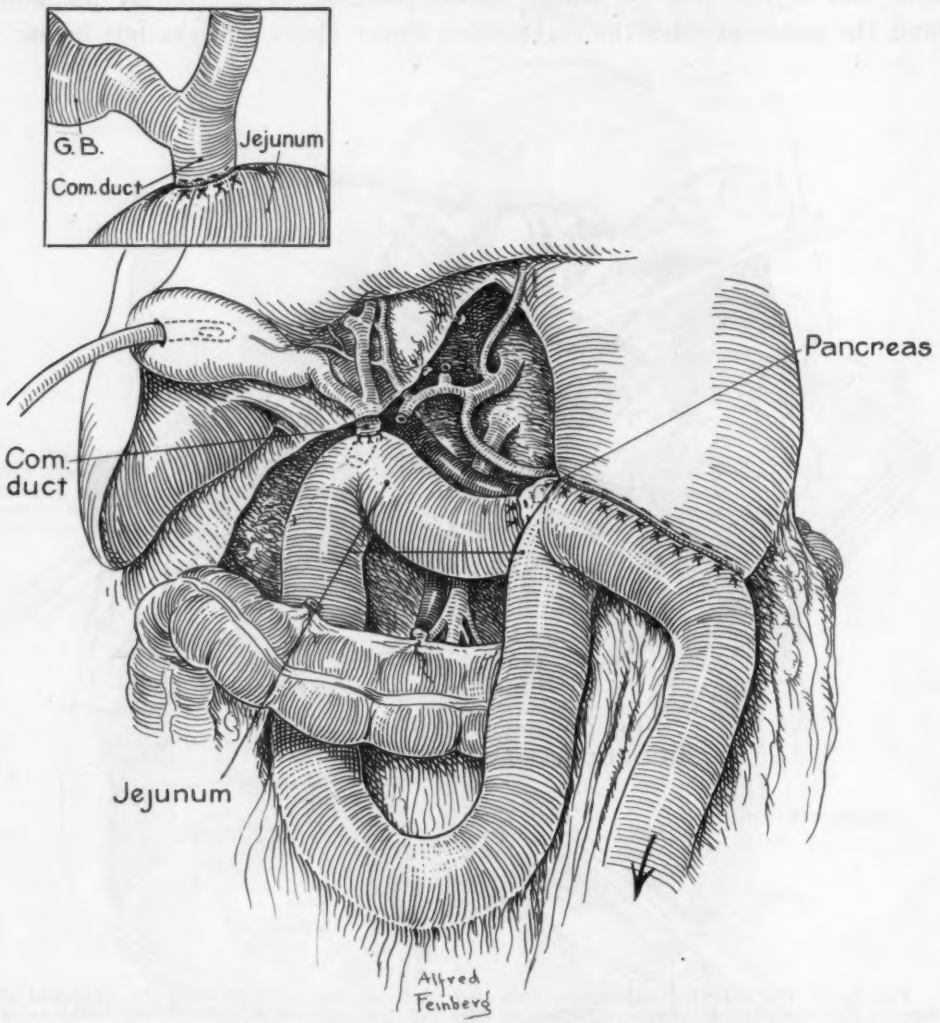

Fig. 6.—Reconstruction of the gastrointestinal tract; Retrocolic end-to-end pancreaticojejunostomy and end-to-side choledochojejunostomy; antecolic gastrojejunostomy.

moved. At this point the feasibility of dissecting free the superior mesenteric vein can be answered (Fig. 4). If this structure be hopelessly involved, retreat is still a relatively simple matter and is accomplished, first, by removing the tail of the pancreas and, second, by performing an end-to-end anastomosis between the proximal and distal halves of the stomach. If the vein can be freed the operation quickly proceeds by dividing in succession the gastroduodenal artery and the common duct.

8. As the duodenum is further mobilized, attention is directed toward accurate identification and division of the inferior pancreaticoduodenal artery as it arises from the superior mesenteric artery. Division of this vessel permits complete and ready extrication of the terminal duodenum and proximal few centimeters of the jejunum from behind the colon (Fig. 5).

9. Reconstruction of the enteric canal is accomplished by (Fig. 6):

(a) Retrocolic end-to-end pancreaticojejunostomy[2a]

(b) Retrocolic end-to-side choledochojejunostomy or simple implantation of the common duct into the jejunal lumen

(c) Antecolic long-loop isoperistaltic gastrojejunostomy

10. As safety measures, the retroperitoneal space, which it is impossible to reperitonize, is drained through a stab wound in the flank and a cholecystostomy tube is inserted through a separate stab wound just below the costal margin.

11. The wound is closed in layers, employing through-and-through No. 28 stainless steel stay sutures buried beneath the skin and interrupted No. 32 stainless steel sutures, approximating the peritoneum and various fascial planes.

12. Postoperatively the drains are withdrawn whenever the discharge becomes scant and the cholecystostomy tube is withdrawn following demonstration of the patency of the choledochojejunal anastomosis.

DISCUSSION

The initial features of this operation are the maneuvers directed toward determining, if possible, whether or not the superior mesenteric vein is compromised by tumor. It can be hoped that eventually some successful method of avoiding the necessity of preserving this structure may be devised, for it is certainly the weakest point as well as the most frustrating in the entire operative attack upon the pancreatic cancers. Indication that it may be sacrificed is to be found in a case reported by Brunschwig,[5] and in a patient (Case 14) in this series in whom post-mortem examination five days following division of the superior mesenteric vein failed to reveal any significant venous engorgement of the small bowel. In Brunschwig's case there had been a previous pelvic operation as a result of which sufficient venous collaterals may have been established; in the case in this series there was no such antecedent operation. The importance of re-establishing pancreatic drainage is twofold: first, it protects an extensive operative field from being flooded by pancreatic ferments should the ligature upon the duct fail. Second, postoperative studies of pancreatic function by means of the secretin test[6a, b] have proved conclusively in these patients that the anastomoses were patent one, two, and three years postoperatively. Secretin tests were performed in the remaining patients, and though in several there was produced a copious amount of secretion, the presence of pancreatic ferments could not be demonstrated because the specimens had unavoidably become acidified with gastric juice.

The importance of choledochojejunostomy instead of cholecystenterostomy has been well established by Whipple,[7] and a gastrojejunostomy distal to the

biliary anastomosis is accepted as an important feature of the operation if troublesome ascending cholangiitis is to be avoided during both the early and late postoperative periods.

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THE COURSE OF PEPTIC ULCERATION IN ELDERLY PERSONS

A Clinical and Anatomic Study of 122 Cases

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ALTHOUGH the over-all death rates in the age decades of 55 to 64 years and 65 to 74 years declined strikingly between 1911 and 1925 and 1925 and 1935 (Table I), the number of deaths due to gastric and duodenal ulcer rose discouragingly.[1, 2] In Cowdry's *Problems of Ageing*,[3] Ivy suggested that the majority of older people with the disease acquired the lesions when young, but even when one allows for the forgetfulness and confusion of the senescent patient this assumption is not entirely justified. Within the ten years from 1937 to 1947, several authors[4-7] have reported instances of the initial appearance of peptic ulcers in the aged and, because their manifestations here are different from those in the young, diagnosis may be difficult and therapy perplexing.

Therefore, the records of the 122 patients over 50 years of age, with peptic ulcer proved by operation or autopsy, who were treated at the Harborview Hospital between Jan. 1, 1936, and Jan. 1, 1947, have been reviewed and some of the salient peculiarities of this malady in the older age groups brought forward. In this interval, excluding obstetric admission, 122,763 patients entered for treatment, and 4,988 autopsies were done, 101 of them in the present series of peptic ulcers, a post-mortem incidence of 2 per cent.

Twelve of the patients were women; seven with gastric ulcers, four with duodenal, and one with a marginal lesion.

In Table II, *A* shows the distribution of cases in the various decades, *B* the anatomic location of the ulcers according to the age groups, and *C* the average duration of symptoms in months. Supplementary to this last it is apparent that in the sixth decade 56 per cent of patients had histories of gastrointestinal troubles for less than two years, in the seventh decade 50 per cent suffered less than two years, in the eighth decade 76 per cent, and in the ninth decade 67 per cent. In the youngest group six persons denied any symptoms prior to the calamity that led to their operation or death. In patients past the age of 60 years, ten who were able to give satisfactory histories could not recall premonitory digestive disturbances.

Unfortunately, the discomforts of peptic ulceration in the older person, when present, are milder than in the younger person and an undetermined but large percentage of these people do not seek medical care until one of the major complications appears. Table III gives the incidence of these disasters in lesions of the stomach including the pylorus and the duodenum, and it is interest-

Read at a meeting of the Seattle Surgical Society, Oct. 31, 1947.

TABLE I

CHANGE IN ANNUAL DEATH RATES PER 100,000				1911 TO 1925	1925 TO 1935
All causes—white	M	Ages	55-64	-22%	- 6%
			65-74	-20%	- 2%
	F	Ages	55-64	-24%	-10%
			65-74	-21%	- 5%
				1911-1915 FROM 1931-1935	
Gastric ulcer—white	M	Ages	55-64	+54.9%	
			65-74	+26.2%	
	F	Ages	55-64	-44.2%	
			65-74	-55.3%	
				1921-1925 FROM 1931-1935	
Duodenal ulcer—white	M	Ages	55-64	+147.7%	
			65-74	+ 70.6%	
	F	Ages	55-64	No change	
			65-74	+ 50 %	

From Dublin and Lotka.[1]

TABLE II

	AGES BY DECADES			
	50-59	60-69	70-79	80-89
A				
Number of cases	52	31	29	10
B				
Gastric ulcer	24	20	8	3
Duodenal ulcer	21	9	12	6
Pyloric ulcer	5	1	6	1
Marginal ulcer	1		1	
Multiple ulcers				
Gastric	2	3	3	1
Duodenal	2	0	4	0
Both	1	1	3	0
C				
Average duration symptoms (mo.)	56.5	55.1	62.3	27
Symptoms less than 2 yr. (per cent)	56	50	76	67
Average duration symptoms gastric ulcer (mo.)	50	63	67	6.3
Symptoms less than 2 yr. gastric ulcer (per cent)	59	45	71	100

TABLE III

	AGES BY DECADES				
	50-59	60-69	70-79	80-89	TOTAL AFTER 60
DUODENAL ULCER WITH					
Perforation	13	5	6	3	14
Hemorrhage	5	4	7	2	13
Massive fatal hemorrhage	5	3	5	2	10
Obstruction	1	0	1	1	
Intractable pain	3	0	0	0	
GASTRIC ULCER WITH					
Perforation	19	8	3	1	12
Hemorrhage	5	9	7	3	19
Massive fatal hemorrhage	1	6	4	1	11
Obstruction	2	1	1	0	
Intractable pain	3	3	1	0	

ing to note that in patients past the age of 60 years hemorrhage is more common than perforation in the patients with gastric ulcers and as frequent in those with duodenal, whereas before this age perforation is seen about three times more often than bleeding.

DISCUSSION

Because this series comprises only those patients who came to operation or autopsy it does not give a true picture of the over-all incidence of complications or of the years in which the course of the disease is less violent. Between 7 and 10 per cent[8] of the population have peptic ulceration at some time of life. Before the fifth decade of life only about 22 per cent[9] of these persons develop any complication requiring operation and only 4 per cent[8] die of the disease.

In patients past 50 years of age about 20 per cent show some signs of obstruction and about 25 per cent bleed significantly.[10, 11] There is, therefore, a compounding of troubles. Complications are more common in the aged, the more serious ones are the most common, and the patients are progressively less well equipped in all respects to cope with the devastations of their illness.

Explanations of the development of the greater hazards are only tentative but require discussion because they influence the treatments to be considered.

The increased incidence of gastric ulcer over duodenal ulcer is most important be it due to failure of some stomachs to empty more rapidly as most do when a person ages,[8, 12] to circulatory lesions in the gastric mucosa,[8] or to dietary fadism or malnutrition[13] from disinterest in food. In published reports the mortality from gastric ulcer in all age groups is greater (22:1) than that from duodenal ulcer.[1] And because of the ever-present likelihood of cancer in gastric lesions the incidence of operation for them is higher.[9] Because their initial appearance is usually at a later age than duodenal ulceration the hazard of operation is greater.[14]

It is the opinion of some[15] that, in general, gastric lesions, though potentially more dangerous, respond to medical treatment better than duodenal ones and it is therefore desirable to employ all diagnostic measures available in the elderly patient to segregate the malignant from the benign lesions. In doing this the gastrointestinal series and gastroscopy performed by the experienced observer are accurate methods (about 80 per cent),[16] but the routine gastric analysis done on only one occasion is much less helpful than in the younger person. Table IV shows the average peak rise of free hydrochloric acid following either 120 c.c. of 7 per cent alcohol, histamine, or both in the thirty-five patients in whom the test was done in this study. In patients past the age of

TABLE IV

	AVERAGE PEAK OF FREE HYDROCHLORIC ACID AGES			
	50-59	60-69	70-79	80-89
Gastric ulcer	8 cases 50.7°	8 cases 28°	6 cases 31°	1 case 0
Duodenal ulcer	7 cases 60.2°	1 case 30.2°	2 cases 28.5°	2 cases 47°

60 years there were five instances of achlorhydria, four of them in the presence of proved benign gastric ulcers, and the fifth in a 74-year-old man who had had abdominal symptoms for only four months; he subsequently died after acute perforation of a chronic duodenal ulcer.

The low average level of gastric acidity in the patients over 60 years of age might be kept in mind when therapy is considered. It is unreasonable to expect that neutralizing substances will accomplish as much in the hypochlorhydric patient as in the person secreting excessive amounts of acid. There is evidence, however, that the retention of gastric juices may be important in perpetuating peptic ulcer[17] and it has been repeatedly shown that the introduction of acid into the stomachs of elderly persons delays their emptying time significantly.[18] In this review three patients were found in whom the onset of symptoms due to peptic ulcer followed the administration of ammonium chloride used as an adjuvant in the treatment of heart failure. This is probably not coincidence and should demand discontinuation of the drug in any elderly individual manifesting digestive complaints.

Perhaps the most rational treatment of the older patients with gastric or duodenal ulcer would stress frequent highly nutritious feedings supplemented by a protein hydrolysate,[19, 20] high vitamin intake, belladonna or its equivalent to promote pyloric relaxation, and a much closer following of the individual than is customary. Many will have reached a state of indifference to the outcome of their illnesses and are reluctant to alter the habits of many years. If they and their physicians can be made to realize that an ulcer late in life is immeasurably more dangerous than in youth, the inconveniences of the therapy might be more gracefully accepted.

Although there are, as yet, no data to outline the way, criteria for surgical intervention cannot be the same for the old as for the young.[21] There is a trend toward immediate operation where massive hemorrhage appears[22] and the greater frequency of hypertension and of vascular rigidity makes resection of the bleeding area in the elderly almost obligatory. In this series twenty-one of the thirty-two patients who bled died of massive hemorrhage. It is unlikely that the operative mortality, had an aggressive attitude been taken, would have exceeded 65 per cent.

As in other studies,[23] deaths due to perforation of an ulcer in the aged increase in direct proportion to the interval between perforation and operative repair and few patients recover when the defect is not closed by suture.

It is in the group where surgical treatment may be elective that standards of evaluation are different. The tendency is to delay operation and then to do as little as one may hope will suffice. Vagotomy[24] because of its technical simplicity is alluring but, on theoretical grounds, seems a poor choice. The advantage of further reduction in gastric acidity, already low, is overbalanced by the prospect of increasing gastric retention.[25, 26] And the few operative casualties reported during vagotomy,[27] due to vagovagal reflexes or other effects on the heart and respiration, have been in the older patients.

If gastroenterostomy is combined with vagotomy a more ideal procedure is obtained but one is tempted to omit the latter step when the circulatory reserve is impaired.

Certainly both are inadequate for the control of bleeding and nothing less than gastric resection should then be chosen. With the improvements in anesthesia, and pre- and postoperative care now available in most hospitals, a more bold approach to surgical treatment should be adopted and one can reasonably anticipate better control of the ravages of peptic ulceration in the aged.

SUMMARY

1. In elderly persons death rates due to peptic ulcer are increasing. Therefore, 122 known cases in patients over 50 years of age entering Harborview Hospital in the last eleven years are reviewed.

2. Between the sixth and eighth decades of life about one-half of the patients with peptic ulcer sufficiently severe to require hospitalization gave histories of gastrointestinal symptoms of less than two years' duration. In the eighth and ninth decades over two-thirds had noticed the discomforts of their disease for less than two years.

3. Sixteen individuals had no symptoms prior to the appearance of a major complication of peptic ulceration.

4. In patients past the age of 60 hemorrhage is more common than perforation and the bleeding is often massive.

5. Peptic ulcer in the aged is not accompanied, as a rule, by gastric hyperacidity though prolonged retention of stomach secretions is not uncommon.

6. In three instances symptoms of a subsequently proved ulcer first appeared after the use of ammonium chloride in the treatment of cardiac decompensation.

7. The treatment of peptic ulcers in the elderly patient cannot be standardized until further data are available but a plea is made for the segregation of the patients with ulcers making the initial appearance in later life, for a more aggressive attitude toward surgical treatment of the complications, and for the publication of mortality statistics of elective operations by age groups.

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TANTALUM FOIL CUFFS IN PERIPHERAL NERVE SURGERY

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FOLLOWING World War I the general consensus of opinion was that the use of cuffs of any material to surround damaged or repaired peripheral nerves was of little value.[1-3] The common materials used had been sections of vein or artery, fresh or fixed, fascia, Cargile membrane, and various metallic materials. Just prior to World War II the new metal tantalum was developed for surgical use and it was strongly urged that it be used in peripheral nerve surgery particularly. The rationale of its use was that it was an inert metal and so would not result in reaction or adhesion formation and that if used as a smooth cuff about the nerve it would prevent ingrowth of scar tissue into the suture line or damaged nerve.[4-8]

This opinion was confirmed by short-term results with nerves, both experimental and clinical, when upon reoperation almost invariably a smooth pseudomembrane was found both outside and inside the foil.[5, 7] However, as time went on and more and more nerves were re-explored late, more cases were found in which there was dense scar tissue formation both outside and inside the foil and in many instances marked fragmentation of the foil was found.

Fortunately, sufficient foil was not available in all neurosurgical centers at all times so that we have been furnished with a control series. The present study is an attempt to judge, from one small series of cases, the relative value of the use of tantalum foil.

The two groups of cases are not exact duplicates, but they are of sufficient similarity to warrant broad deductions. The chief discrepancies are in the time interval between injury and operation, which is much greater in those nerves repaired without foil (see Tables I and II). This should favor those nerves treated with foil as it is fairly well accepted that early operation is the procedure of choice. It will also be noted that the average gap between the neuroma and glioma is greater in those nerves sutured without foil. This also should favor the group with foil according to usual opinion, which has favored suture of nerves without tension. So far as the relative numbers of each individual nerve are concerned, one may see that they are very similar, there being no great discrepancies.

Sensory nerves have not been included in the tables because the number repaired without foil so greatly outweighed the number with foil. Only those cases have been included in which there is certain knowledge that foil was or was not used. Approximately 500 questionable cases were excluded. Only cases in which sufficient time had passed for adequate follow-up have been included. This factor, in all probability, weights the statistics in favor of those patients treated without foil as they were more frequently the later cases and so a very much greater percentage has been excluded for insufficient follow-up.

TABLE I. NEURORRHAPHIES WITH AND WITHOUT FOIL

	NO. CASES	AV. TIME (MO.)*	AV. GAP (CM.)†	RESULT (RATED) 4	3	2	1	0	AVE. RESULT	PARESTHESIA	TRIGGER POINT	NO. PATIENTS REOP.	NO. PATIENTS IMPROVED‡
Brachial plexus with foil	6	1.3		0	2	3	1	0	2.2	0	0	0	0
Brachial plexus without foil	5	5.4	1.7	1	2	1	1	0	2.6	0	0	0	0
Radial with foil	19	3.2	1.0	3	12	3	1	0	2.9	0	0	0	0
Radial without foil	8	6.0	1.3	3	4	0	1	0	3.1	0	0	1	1
Median with foil	21	4.0	0.8	1	12	6	2	0	2.5	4	4	2	2
Median without foil	50	9.1	1.5	7	36	6	1	0	2.9	2	0	2	1
Ulnar with foil	56	3.5	1.1	0	9	31	15	1	1.8	7	14	8	4
Ulnar without foil	84	6.2	2.1	1	26	40	16	1	2.1	3	4	9	3
Musculocutaneous with foil	2	2.5	0	1	1	0	0	0	3.5	0	0	0	0
Musculocutaneous without foil	2	6.5	3.5	1	1	0	0	0	3.5	0	0	0	0
Sciatic with foil	14	3.9	1.6	1	1	10	2	0	2.0	0	0	2	1
Sciatic without foil	19	5.5	2.0	0	8	6	3	2	2.3	0	0	4	1
Peroneal sciatic with foil	12	2.4	0.1	2	1	7	1	1	2.1	1	0	2	0
Peroneal sciatic without foil	6	5.2	0	0	0	2	2	2	2.0	0	0	1	0
Tibial sciatic with foil	3	3.6	0	0	0	3	0	0	2.0	2	0	1	0
Tibial sciatic without foil	2	3	0.8	0	2	0	0	0	3.0	0	0	0	0
Peroneal with foil	7	2.5	0	1	1	2	1	2	1.7	0	0	3	3
Peroneal without foil	19	6.0	2.3	3	5	6	4	1	2.3	2	2	2	0
Tibial with foil	12	8.7	1.2	2	4	3	2	1	1.9	0	0	1	0
Tibial without foil	3	3.3	0	0	2	0	0	1	2.0	2	1	1	0
Total with foil	143	4.0	1.1	9	41	65	23	5	2.18	16	19	19	10
Total without foil	207	6.5	1.9	18	88	64	30	7	2.4	6	4	20	6

*Between injury and operation.
†Between neuroma and glioma.
‡After reoperation.

In the tables the return of function is recorded as follows:

4. Return of some function in all muscles innervated plus return of sensation; none necessarily normal
3. Return of some function in 50 to 75 per cent of the muscles and/or sensory area
2. Return of one element to 50 per cent of elements
1. Return of one element
0. No return of function other than Tinel's sign
P. Paresthesia in the sensory area
T. Moderate to severe trigger point

There is a total of 523 cases, of which 362 were neurorrhaphies. Of this latter number 145 nerves were wrapped in foil and 208 were not wrapped. (Of those wrapped, reoperation was deemed necessary in 21 cases or 14.4 per

TABLE II. NEUROLYSES WITH AND WITHOUT FOIL

	NO. CASES	AV. TIME (MO.)*	RESULTS (RATED)					AV. RESULT	PARESTHESIA	TRIGGER POINT	NO. PATIENTS REOP.	NO. PATIENTS IMPROVED†
			4	3	2	1	0					
Brachial plexus with foil	5	2.8	2	2	1	0	0	3.0	0	0	0	0
Branchial plexus without foil	3	2.0	0	1	1	0	0	2.5	0	0	0	0
Median with foil	30	3.2	7	11	10	2	0	2.7	10	7	8	6
Median without foil	24	6.2	15	9	0	0	0	3.2	2	0	0	0
Ulnar with foil	22	3.4	2	8	10	1	1	2.4	1	6	4	3
Ulnar without foil	22	8.6	8	9	3	2	0	3.0	0	0	1	1
Radial with foil	10	2.3	3	7	0	0	0	3.3	0	1	0	0
Radial without foil	9	6.7	5	3	1	0	0	3.4	0	1	1	0
Sciatic with foil	6	6.4	3	0	1	1	1	2.3	1	0	1	1
Sciatic without foil	12	7.3	2	5	4	1	0	2.6	6	1	0	0
Peroneal with foil	4	7.7	0	2	1	0	1	2.0	1	1	1	1
Peroneal without foil	6	4.6	3	2	1	0	0	3.3	0	1	0	0
Tibial with foil	3	6.3	1	1	1	0	0	3.0	0	0	0	0
Tibial without foil	4	9.7	2	1	1	0	0	3.2	0	1	0	0
Total with foil	80	4.1	16	34	23	4	3	2.5	13	15	14	11
Total without foil	79	7.1	35	30	11	3	0	3.2	8	4	2	1

*Between injury and operation.
†With reoperation.

cent. Of those not wrapped in foil, reoperation was deemed necessary in 22 or 10.5 per cent.) There is a total of 161 neurolyses, of which 83 had foil wrapping and 79 were without wrapping. (Of the 83 wrapped, 14 of them or 16.8 per cent were reoperated upon and of the 79 not wrapped only 2 of them or 2.5 per cent were reoperated upon.) The principal cause for reoperation in these patients was the presence of a trigger point.

It will be noted that the figures do not coincide with those in the tables. In the neurorrhaphies this is due to the fact that 3 patients were reoperated upon without sufficient time for follow-up, 2 in the group with foil and 1 in the group without foil. In the neurolyses it is due to the fact that 3 femoral nerves treated without foil are not included, because there were no femoral nerves with foil. None of these femoral nerves were reoperated upon.

TABLE III. RESULTS OF NEURORRHAPHIES WITH AND WITHOUT FOIL

WITH FOIL			WITHOUT FOIL		
NUMBER	PER CENT*	RATED	NUMBER	PER CENT*	RATED
9	6.5	4	18	8.5	4
41	29	3	93	45	3
65	45	2	63	30	2
23	16	1	31	15	1
5	3.5	0	3	1.5	0
Total 143			208		
16	11	Paresthesia	6	3.2	Paresthesia
19	15	Trigger points	4	2	Trigger points

*Percentages were computed to nearest whole figure except in those below 10, when they were computed to the nearest .5 per cent.

From an observation of Table III, it will be observed that though the results favor the nerves treated without foil these are not of sufficient difference to be of real statistical significance. When one considers the number of cases with paresthesia or trigger points the figures are definitely in favor of not using foil.

TABLE IV. RESULTS OF NEUROLYSES WITH AND WITHOUT FOIL

	WITH FOIL			WITHOUT FOIL		
	NUMBER	PER CENT*	RATED	NUMBER	PER CENT*	RATED
	16	20	4	35	44	4
	34	24	3	30	38	3
	23	28	2	11	14	2
	4	5	1	3	4	1
	3	4	0	0	0.0	0
Total	80			79		
	15	18	Paresthesia	4	5	Paresthesia
	14	17	Trigger points	2	2.6	Trigger points

*Percentages were computed to nearest whole figure except in those below 10, when they were computed to the nearest .5 per cent.

In a review of the patients in whom reoperation was carried out it seems certain that the nerves from which foil was removed were more scarred and damaged and the operative procedure was much more difficult than in those in which the nerve was not wrapped in foil. If the foil be intact, the scarring is most dense at the edges of the foil, upper and lower, and where the horizontal edges overlap both inside and outside. At times it is very difficult to separate these edges from the nerve and they may seriously cut into the nerve. Wherever there are any cracks in the foil there will be increased scarring. In at least 3 cases the foil was fragmented and small bits were imbedded deeply in the nerve. In 2 cases the nerve was so badly chewed up that neurorrhaphy was absolutely necessary (Fig. 1, *A*, *B*, and *C*). In 2 cases there was severe constriction of the nerve to less than one-half of the diameter of the nerve above, and only scar tissue was present in the constricted area, no nerve fibers being seen even on microscopic examination (Fig. 2). Of those patients in whom only a neurolysis had been done there were several on whom adequate notes were present for both operations. In at least two of these cases it is certain that the damage to the nerve was minimal at the first operation when the foil was applied, whereas at the second operation there was serious scarring and neuroma formation (Fig. 3). In other cases the changes ranged from marked edema of the nerve to serious scarring, moderate neuroma formation, or partial constrictions. Strangely enough, there were no cases of definite separation of the suture line.

In the nerves reoperated upon without foil there were 3 with separation of the suture line. There were no cases of marked constriction and in those patients on whom both notes were adequate there were no instances in which the condition of the nerve had definitely degenerated between the operations.

It is of note that of the nerves with foil which were reoperated upon, 60 per cent showed improvement after the second operation and all but two lost their trigger points. Of the patients without foil who were reoperated upon, only 27 per cent showed improvement after the second operation. These figures would lead one to believe that the foil in these cases was actually a harmful element.

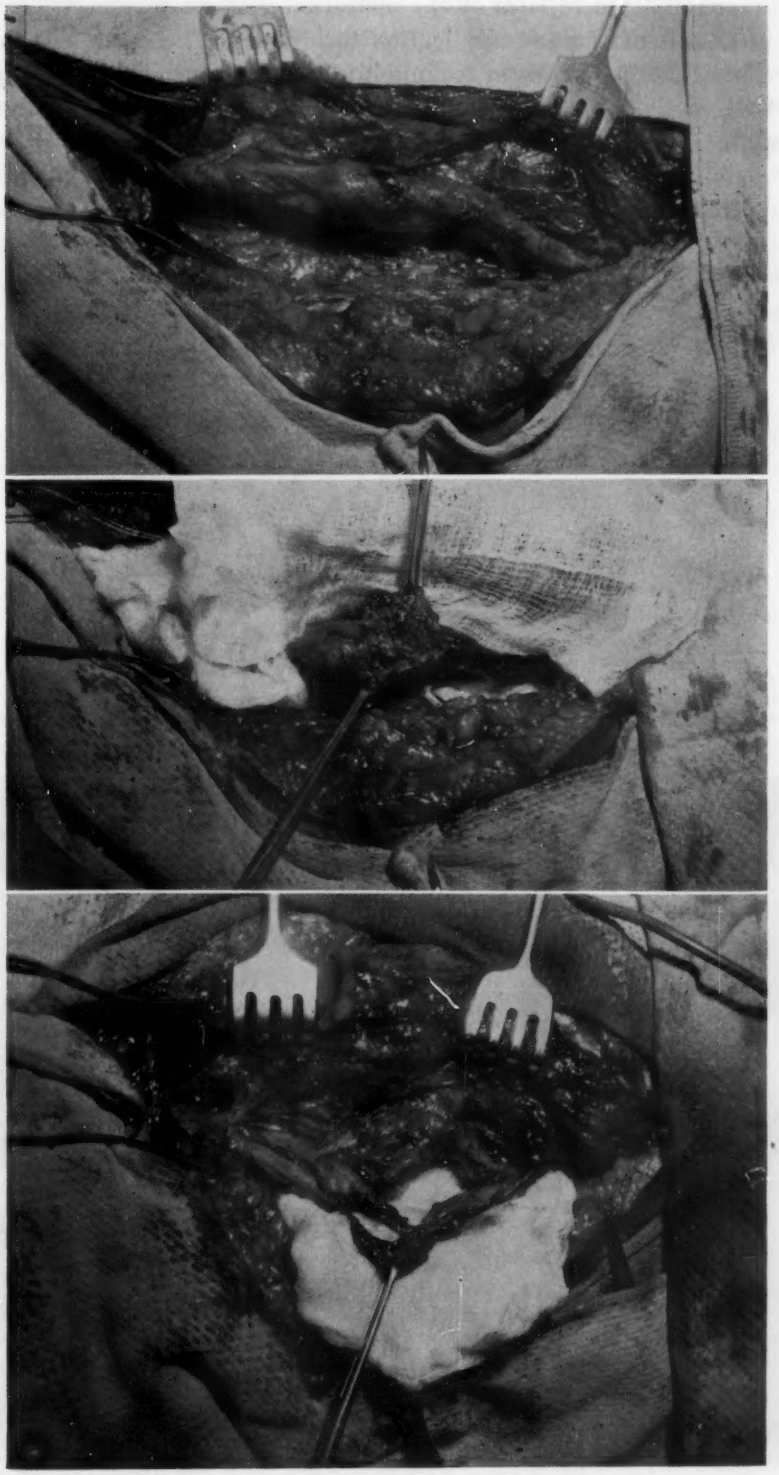

Fig. 1.—*A*, Reoperation of sciatic nerve wrapped in foil twenty months previously; note increased size of nerve in operative area. *B*, Same nerve, beginning removal of foil; note fragmentation and marked thickening of capsule, many fragments embedded in nerve substance. *C*, Appearance of nerve after complete removal of foil; neuromas proximally on both peroneal and tibial trunks, normal trunks above and below.

Unfortunately, the reports of the operation in most instances are not complete as to details of the foil application technique. The cases with bad result may have been due to errors in technique of application. These might include (1) cracking of the foil while preparing or applying it or (2) sutures to hold the foil in place tied too tightly so as to constrict the nerve.

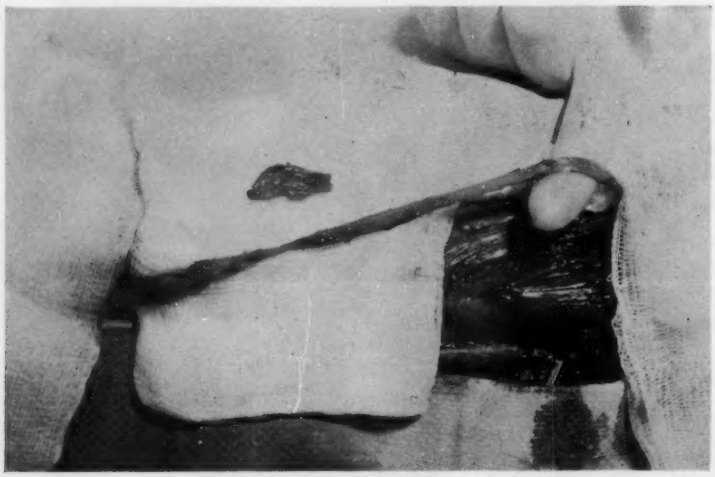

Fig. 2.—Ulnar nerve after removal of foil, eighteen months after operation, complete paralysis; note marked constriction. Pathology report revealed scar tissue only in narrowed area.

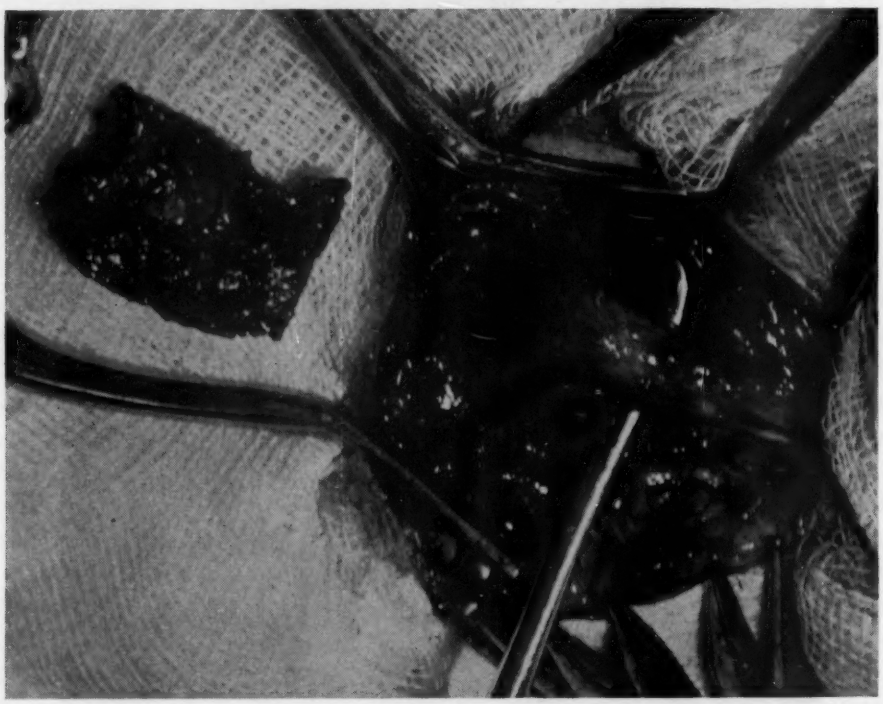

Fig. 3.—Neuroma present after removal of foil from median nerve. This was one of the nerves with adequate previous operative note which reported nerve normal in appearance. foil was applied only to prevent constriction by surrounding scar.

If tantalum foil is to be used, infinite care must be used in preparing and applying it. Perhaps the most satisfactory technique is to prepare the cuff by wrapping the piece of foil of proper size around a smooth round object slightly smaller in diameter than the nerve to be wrapped. The one edge is then drawn around the nerve and the instrument with its foil is crossed over this edge, drawn around the nerve, and then the instrument withdrawn. The roll of foil will then snap into place on the nerve firmly but not so as to constrict it. No ligatures will be necessary to hold it in place (Fig. 4). A second method to be used in neurorrhaphies, when enough room is available, is to place a formed cuff over one end of the nerve up onto the trunk and then to slip it back over the suture line when suture is completed. These methods were well illustrated by White and Hamblin.[4]

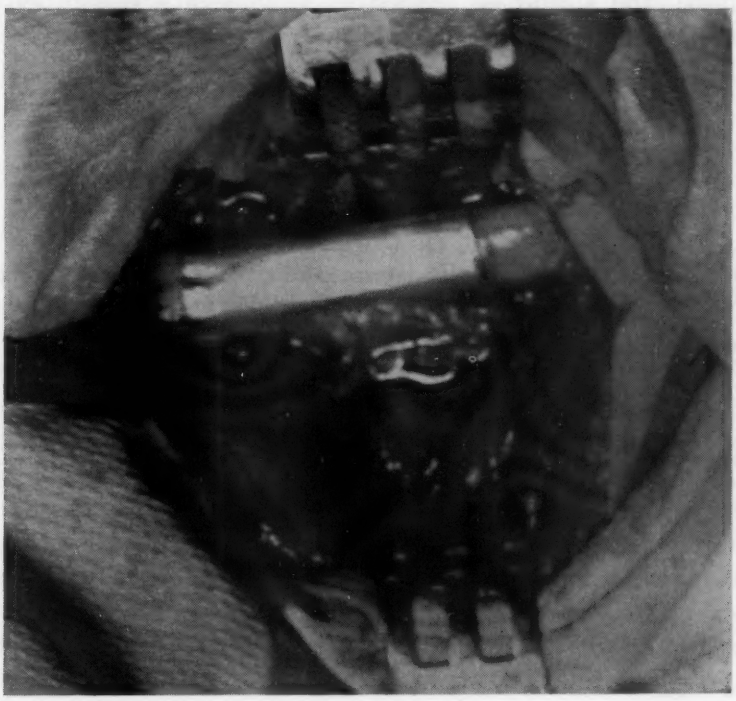

Fig. 4.—Photograph showing appearance of properly applied cuff at time of operation; note smooth contour, small depression at distal end to be elevated so as not to cause pressure.

The use of tantalum foil in two-stage procedure is unquestionably justified and of great value. If applied at the first stage procedure one finds at the second stage, if done in less than two months, a smooth pseudomembrane surrounding the foil and between the foil and the nerve. This tends to make at least temporarily a smooth sliding surface for the nerve at the suture line. The only disadvantage found has been that in some cases there is a definite tissue reaction of the nerve sheath with fairly marked edema. This type of sheath is definitely more friable than the normal sheath and sutures tend to pull out easily. Whether or not this type of nerve tends to do poorly has not been determined.

In only 3 cases was another material used for a cuff. One was a lead bone wax cover which was later removed. Two patients with use of fibrin film cuff were examined. Both showed satisfactory recovery. Another more satisfactory method of forming a cuff from the nerve sheath will be reported in a later communication.

CONCLUSIONS

1. Tantalum foil as a cuff in peripheral nerve surgery has not been proved to be of value in this particular series of cases.

   (a) Since its proper application is time consuming and the material relatively expensive, its routine use is not considered advisable.

   (b) If a satisfactory result has not been obtained or if a severe trigger point or paresthesia remain, the foil should be removed.

2. If used, foil should be applied so as to give a smooth even covering without pressure. Methods are described for reaching this ideal.

3. The use of foil in the first of two-stage procedures is considered of value.

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TWENTY-SEVEN YEARS OF PROSTATIC SURGERY AT BELLEVUE HOSPITAL

A Study of Comparative Mortality Rates

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DURING the past quarter century many bitter arguments have been waged concerning the relative merits of the various methods of operative treatment for benign prostatic hypertrophy. Many changes have taken place in the methods used during these years of discussion and development of new operations. It seems appropriate, therefore, at this time to rise above the smoke of battle and evaluate the progress which has been made. The study presented includes all patients with benign prostatic hypertrophy treated surgically at Bellevue Hospital between 1920 and 1946. The chief interest lies in the comparative mortality rates, for the early follow-up records were inadequate for statistical analysis.

Table I has been arranged to show the total number of patients with benign prostatic hypertrophy operated upon during each of the twenty-seven years. Figs. 1 to 5 show (1) the annual mortality rate for all operative procedures, (2) the annual mortality rate for transurethral resection, (3) the annual mortality rate for the second stage of a two-stage prostatectomy, (4) the annual mortality rate for one-stage prostatectomy, and (5) the annual mortality rate for cystotomy alone.

A study was made of the 2,221 consecutive patients treated in the twenty-seven-year period; all post-mortem reports were reviewed.

Table I, which gives the total number of operations each year, shows a gradual upward curve from 42 cases in 1920 to 153 in 1946. The increase in yearly operative cases is due to several factors, the most important of which undoubtedly is the realization by the medical profession that patients who are treated for prostatic obstruction before they are in extremis have a much better chance of surviving the surgery than those in whom surgical treatment is delayed. Another important factor has been the increasing confidence of patients in the outcome of surgery, having observed their friends relieved of their symptoms by operation.

Fig. 1 shows the annual mortality rate of all operative procedures for benign prostatic hypertrophy during the twenty-seven years studied. When it is realized that one out of every two patients subjected to operation died, as in 1922, it is easy to understand why their friends and associates failed to seek surgical relief for prostatism with any degree of hope of recovery. It is gratifying to find that the mortality rate has decreased from 50 per cent to 4.6 per cent in recent years. At this point it would seem worth while to ask how this reduction in mortality has been achieved. One has only to read the charts of 1920 to realize how great has been the improvement in the pre- and postoperative care of these patients over the years. In the early period covered by this study

TABLE I

YEAR	NUMBER OF OPERATIONS	NUMBER OF DEATHS	MORTALITY (PER CENT)
1920	42	18	42.8
1921	36	17	47.2
1922	60	31	50.2
1923	47	16	34.0
1924	49	18	36.7
1925	52	16	30.8
1926	60	18	30.0
1927	50	8	16.0
1928	51	7	13.7
1929	72	13	18.1
1930	69	16	23.2
1931	71	7	9.9
1932	66	9	13.6
1933	91	19	20.9
1934	98	19	19.4
1935	83	20	24.1
1936	89	18	20.2
1937	92	20	21.7
1938	110	12	10.9
1939	120	14	11.6
1940	121	12	9.9
1941	107	14	13.1
1942	100	24	24.0
1943	105	7	6.7
1944	123	12	9.8
1945	104	8	7.7
1946	153	7	4.6
	2,221	400	Average 18.0

the dangers of intravenous therapy were so great that it was rarely used. What parenteral fluids were given were administered subcutaneously or, occasionally, by proctoclysis. Blood transfusions were uncommon. Urotropin, methylene blue, and oil of sandalwood were the only urinary antiseptics available. The ketogenic diet and mandelic acid therapy, sulfa drugs, penicillin, and streptomycin were as yet unknown. At present a patient is seldom operated upon without the use of at least one, and often several, antibiotics. Hundreds of transfusions and thousands of other intravenous infusions are given annually, including amigen.

It is believed that the advent of the resectoscope has also aided the urologic staff in lowering the over-all operative mortality. It can be seen from Fig. 2 that the mortality rate for transurethral resection has been fairly low since the beginning of its use and in 1946, the year of our lowest over-all mortality rate, 87, or somewhat over one-half of the 153 patients operated upon for prostatic hypertrophy, had transurethral resections and with a mortality rate of only 3.4 per cent.

One very important factor in reducing the over-all annual mortality rate has been the increase in the number of the resident staff and the length of time required for training. From 1920 to 1930 much of the surgery was done by the visiting staff of urologists. In the last decade most of the surgery has been performed by the resident staff whose interest in the pre- and postoperative care of the patient has been enhanced by greater participation in the surgery done.

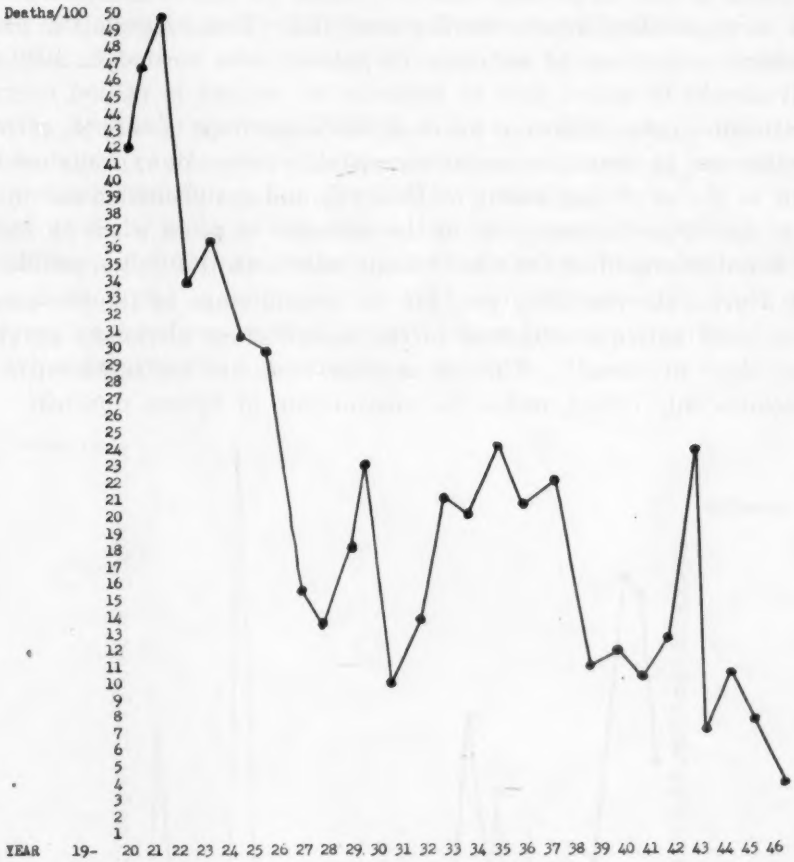

Fig. 1.—Annual mortality rate for all procedures, 1920 to 1946.

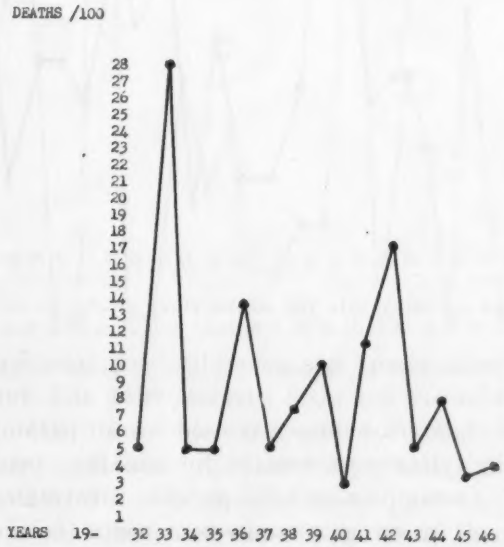

Fig. 2.—Annual mortality rate for transurethral resection, 1932 to 1946.

In 1920, of the 42 patients operated upon 11 had a cystotomy only; in 1946 the corresponding figure was 3 out of 153. This suggests the possibility that a higher percentage of seriously ill patients was treated in 1920 than in 1946. It should be noted that at Bellevue no patient is denied operation if such treatment, in the opinion of the staff, holds any hope of success, even though this practice may increase the operative mortality rate. Many comatose patients are taken to the operating rooms at Bellevue and a sufficient number of them survive to justify cystotomy even in the presence of coma when an indwelling catheter is not tolerated or for some reason catheterization is impossible.

Fig. 3 gives the mortality rate for the second stage of the two-stage prostatectomy. All patients subjected to the second stage obviously survived the cystotomy done previously. These cystotomy cases are not included in the list of cystotomies only, which makes the compilation of figures difficult.

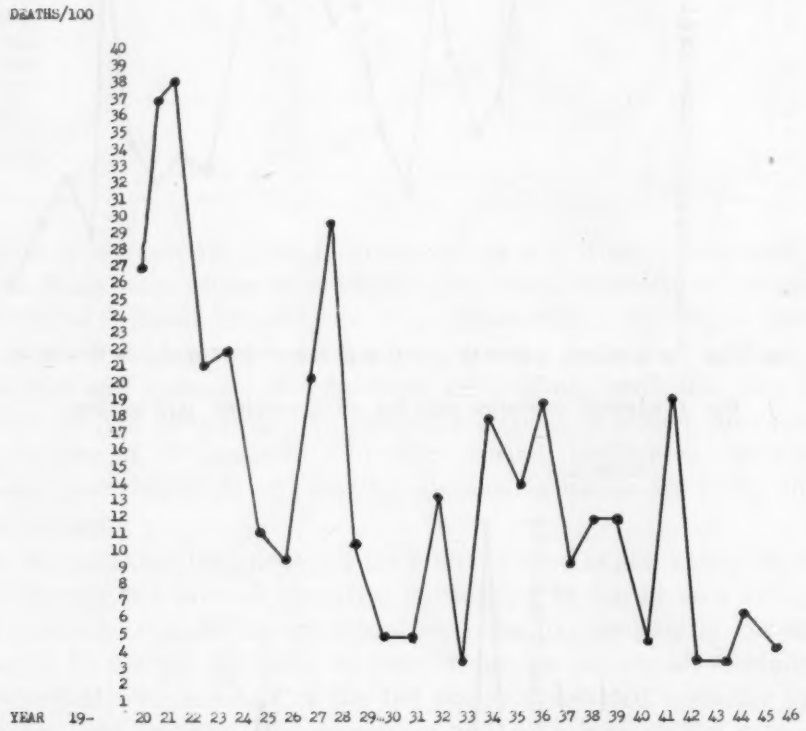

Fig. 3.—Annual mortality rate for second stage prostatectomy, 1920 to 1946.

A two-stage prostatectomy has generally been considered the operation of choice in patients who are not good surgical risks and during the early years of this report a two-stage procedure was used for all patients save those in very good condition. The latter were treated by one-stage prostatectomy or transurethral resection. At the present time patients are treated by a transurethral resection, perineal, or a one-stage prostatectomy with the exception of those with severe uremia, infection, and those with strictures.

The gradual lowering of the mortality rate for the second of a two-stage operation in the past twenty-five years cannot be attributed to great improvement in technique but must be an index of the value of the supplementary therapy.

In Fig. 4, giving the results of the one-stage suprapubic prostatectomy, it will be seen that the average twenty-seven year mortality is 13 per cent, which is lower than the mortality rate for all operative procedures.

There appears to have been considerable interest in one-stage operations from 1928 through 1931, as almost one-half of the operations were done by the one-stage method and the mortality in 1931 and 1932 was only 3 per cent—the lowest rate that has been reached by any procedure, in a significant number of cases, for benign prostatic hypertrophy at Bellevue.

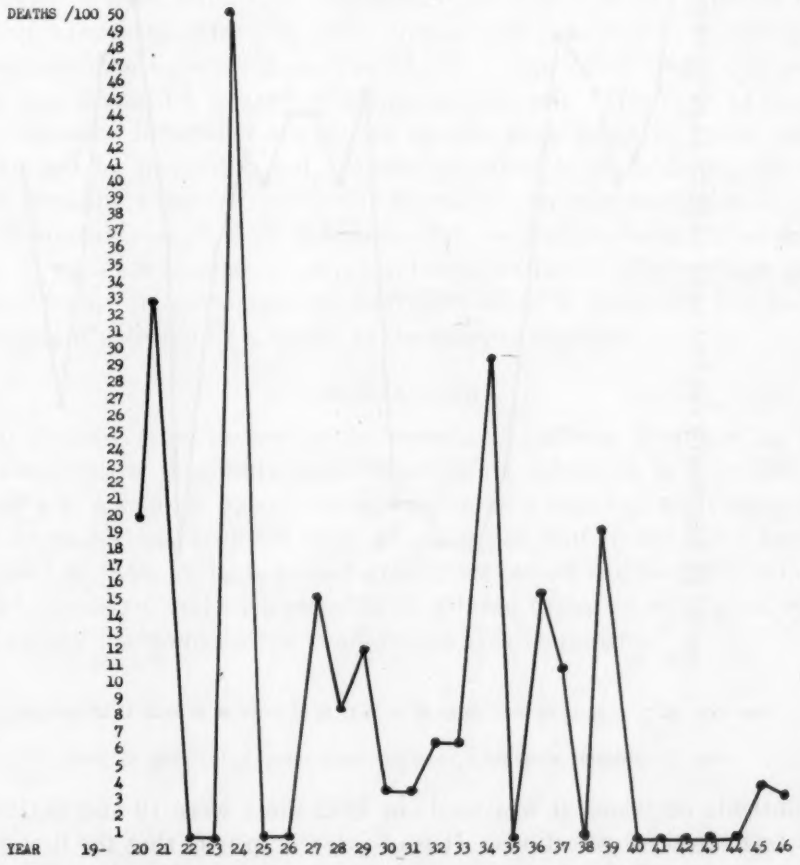

Fig. 4.—Annual mortality rate for one-stage prostatectomy, 1920 to 1946.

The recent mortality curve again shows a marked decrease for the one-stage operation, in fact, 86 consecutive one-stage prostatectomies have been done in the past seven years with only two deaths, an operative mortality of 2.3 per cent. It is worthy of comment that one of the two deaths occurred in a patient admitted to the hospital for severe bleeding from the prostate. A one-stage

prostatectomy was carried out when all other means of checking the bleeding had proved unsuccessful; however, the patient died of shock from excessive loss of blood.

A review of these figures gives the impression that the merits of the one-stage procedure were proved years ago and overlooked for many years until recently.

In Fig. 2 the curve represents the mortality rate for transurethral resection which will be seen to improve as time goes on. The resectoscope became available in 1932 and since then each year has brought an increase in the num-

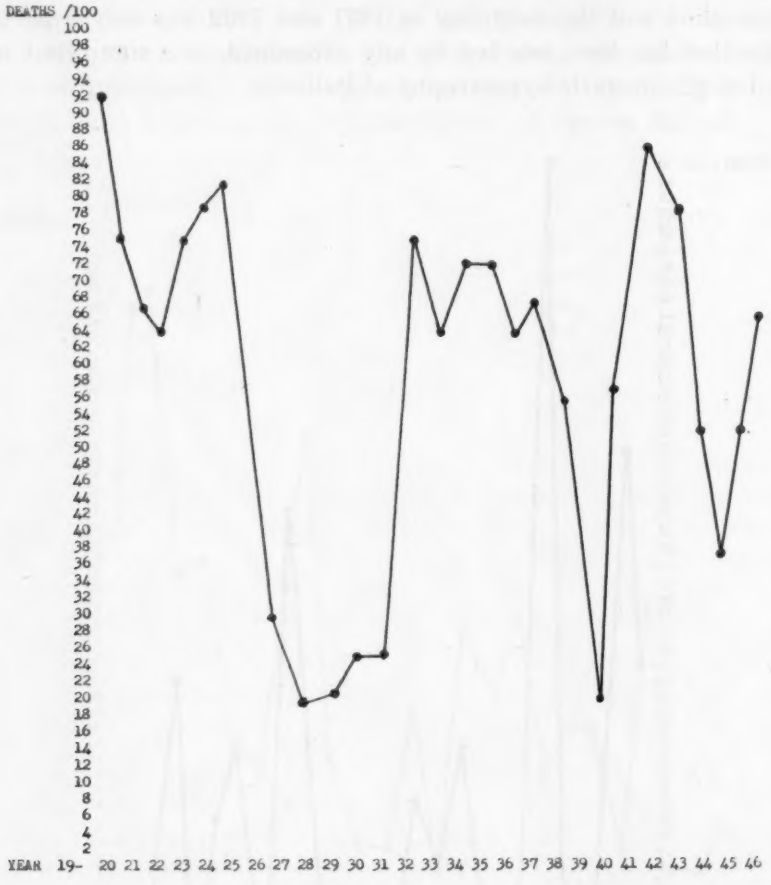

Fig. 5.—Annual mortality rate for cystotomy only, 1920 to 1946.

ber of patients on whom it was used; in 1932 there were 19 and in 1946 there were 87 transurethral resections. It is of interest to note that the first year this instrument was used the death rate was only 5 per cent, but the following year it rose abruptly to 28 per cent. This suggests that after the successful results of the first year attempts may have been made by less experienced operators to remove overlarge glands by this route. It has become the policy at Bellevue to reserve transurethral resection for glands which we anticipate will weigh less than 50 grams. This is the only limitation of its use and often patients with severe cardiac disease and elderly debilitated patients are subjected to this procedure as a matter of choice.

Prostatectomy by the perineal route has been carried out in only 81 cases during the past twenty-seven years, and 12 of the 81 were done in 1946. There has been little enthusiasm for this approach to the prostate gland and there have been years in which no perineal prostatectomies were done and in others there were only one or two. The infrequent use and unpopularity of this procedure is reflected in the mortality rate which averages 19 per cent for the twenty-seven years, an appallingly high figure.

It should be stated that 12 patients were subjected to perineal prostatectomy in 1946 by the technique advocated by Dr. Elmer Belt, without one death.

The charts and autopsy records of all patients who died after operations for benign prostatic hypertrophy during the period reviewed were studied in an effort to determine the chief cause of death. It is obvious that there are almost always several factors which contribute to the fatal outcome and it is difficult to tell which is most important. Certainly the most common cause of death in the earlier cases was infection, with uremia and hemorrhage following as the next most common causes. Since the advent of the sulfa drugs and penicillin, infection has assumed a somewhat less formidable role. However, as most of the stubborn urinary infections are caused by the gram-negative bacilli which are not controlled by penicillin and are also resistant to sulfa drugs, the urinary infection remains a serious problem. Streptomycin promises to be of material help in the treatment of these infections but we hesitate to use it except in the severely ill patients because of unfavorable side effects. Hemorrhage is a more important factor in postoperative morbidity than is generally realized. This fact is amply illustrated by a review of the autopsy findings.

CONCLUSIONS

It is obvious, from reviewing the records of Bellevue Hospital for the past twenty-seven years, that more patients are being subjected to prostatic surgery each year and a smaller percentage are dying as a result of their surgery. The over-all mortality has dropped from 40 or 50 per cent in the early twenties to 4.6 per cent in 1946. This is a most gratifying record and is attributable to the ingenuity, industry, and surgical skill of a large group of urologists who have worked during the twenty-seven years for no greater reward.

UNUSUAL COMPLICATIONS FOLLOWING RESECTION OF CARCINOMA OF THE CARDIAC END OF THE STOMACH

Report of a Case

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DURING the past several years the operation of intrathoracic esophagogastrostomy has gained wide recognition as the procedure of choice in the surgical treatment of neoplasms of the lower third of the esophagus and of the cardiac end of the stomach. More recently carcinoma of the middle third of the esophagus has been successfully removed and by drawing the stomach up to and above the arch of the aorta, intrathoracic esophagogastrostomy has been accomplished in an ever-increasing number of patients.

The purpose of this presentation is to review the course and emphasize several of the pitfalls encountered in the diagnosis and treatment of a patient with cancer of the cardiac end of the stomach.

CASE REPORT

The patient was a 51-year-old man employed in the storeroom of the New York Hospital. He was seen in the Personnel Health Service in October, 1943, complaining of poor appetite of five months' duration. He had previously been in good health save for an attack of right ureteral colic that confined him to the New York Hospital for one month. For five months the patient suffered from loss of appetite. Breakfast and dinner called forth the usual response but at lunch time delay in his work caused considerable tension and desire for food was lost. He developed fullness in the epigastrium about two hours after meals and this was relieved by belching. He lost ten pounds in the five-month period, but on his vacation during the two weeks before admission he regained six pounds and fatigue associated with increased hours of work disappeared.

Physical examination showed no pathologic changes.

It was the impression in the gastrointestinal clinic that he had a functional disorder associated with tension, but in order to rule out organic changes a gastrointestinal series was ordered. Fluoroscopic examination showed a minimal amount of cardiospasm but x-ray examination was reported as showing an apparently normal stomach and duodenum. Examination of the stool for blood gave negative results on one examination and positive on a second. Gastric analysis revealed no free hydrochloric acid even after histamine, and blood flecks were noted in the specimens. Gastroscopic examination was attempted but neither the large rubber lavage tube nor the gastroscope could be passed into the stomach and the patient was referred to the hospital.

Esophagoscopy was done and a polypoid lesion found at the distal end of the esophagus. A biopsy was made and the report of the pathologist was carcinoma of the cardiac end of the stomach. X-ray views of the chest showed no evidence of metastases but throughout the lung fields were several scattered parenchymal nodules and calcified hilar lymph nodes bilaterally.

On the eleventh day after admission, operation was done. Approximately 22 cm. of the left ninth rib were resected and the eighth rib was broken posteriorly. The visceral and parietal pleura were adherent requiring tedious dissection to approach the diaphragm and mediastinum. The esophagus was isolated and a firm lesion palpated at its junction with the stomach. An incision was made in the diaphragm and the capsule of the spleen was found to be fused to the diaphragm. This point of attack was abandoned and another opening made in the diaphragm, nearer the esophageal hiatus. Here again adhesions between what was subsequently found to be the greater omentum and the diaphragm were encountered. The cardiac portion of the stomach was densely adherent to the liver and a portion of the left

lobe of the liver was resected. Numerous large firm nodes in the gastrohepatic omentum that undoubtedly contained carcinoma were also removed in the block dissection.

Division of the esophagus 4 cm. above the upper limit of the tumor and of the stomach 7 cm. from the cardia on the lesser curvature was done. After closing the stomach, it was found that anastomosis with the esophagus could be accomplished only under considerable tension. An attempt was made to isolate a loop of jejunum for the anastomosis but so dense were the intra-abdominal adhesions that small intestine was never even visualized. Accordingly the gastrohepatic omentum was further divided and the stomach sutured under tension to the chest wall. An esophagogastric anastomosis was then accomplished without tension but the tip of the stomach attached to the chest wall was cyanotic. The diaphragm was closed about the stomach and sutured high to the chest wall, relieving tension on the stomach. Two grams of sulfanilamide were sprayed about the suture line and the chest was closed with catgut and buried sutures of silver wire about the ribs.

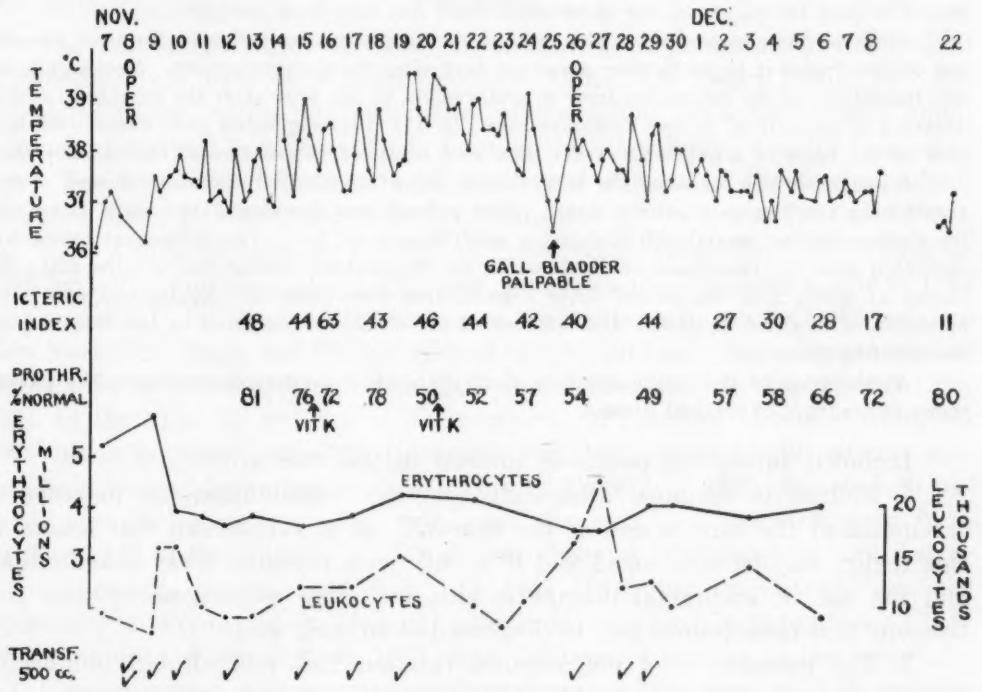

Fig. 1.

The lesion was described* as a serpiginous ulcer with stony hard margins which wandered around the cardiac end of the stomach 7 cm. and extended downward 5 cm. along the axis of the viscus. Outside the organ just beneath this ulcer there was a group of enlarged lymph nodes all massively invaded by stony hard white tumor tissue. The tumor extended up the esophagus for about 2 cm. The liver was not grossly invaded. Microscopic examination showed the tumor to be arising in the gastric mucosa where it was forming long glandular complexes composed of cylindrical cells with numerous mitotic figures. The tumor was found spreading upward in the esophagus beneath the epidermoid lining.

Findings of interest in the patient's postoperative course are recorded in Fig. 1.

The patient was placed in an oxygen tent and did well until the fifth postoperative day, when jaundice was noted. The icteric index was 48 and the prothrombin 81 per cent of normal. Sulfadiazine that had been given (2.5 Gm. twice daily) was discontinued. The patient's temperature ranged from 37 to 39.6° C. and the icteric index rose to 63 by the eighth day after operation. Roentgenograms of the chest showed a pleural effusion on the left.

A small amount of pus drained from the wound on the fourteenth day. He had no complaints until the seventeenth day when he had discomfort in the right upper quadrant of the abdomen and an enlarged tender gall bladder was felt. Bile was vomited. The icteric

*N. C. Foot, pathologist.

index remained about 40, and stools continued to be brown. On the next day a cholecystostomy was done under local anesthesia. The gall bladder was tremendously distended but not grossly acutely inflamed, although microscopic examination of a portion of its wall showed infiltration with polymorphonuclear leucocytes and necrosis. No stones were found.

Several transfusions were given. As bile continued to drain from the gall bladder, the icteric index fell and the patient improved symptomatically.

The cause of the patient's jaundice was the subject of speculation. The possibility of hepatitis with jaundice due to sulfadiazine, of which the patient received 25.5 Gm. during six days, was considered but this could not have accounted for the tremendous distention of the gall bladder and for the same reason a transfusion reaction was not considered a likely cause. Because of the considerable tension under which the stomach had to be sutured to effect the esophagogastric anastomosis it was thought that partial kinking of the common duct might have occurred with resultant obstruction. Since the patient vomited bile and continued to pass brown stools, the obstruction could not have been complete.

Study of the plasma prothrombin level showed a progressive fall from the time jaundice was observed until it began to clear about six days after the cholecystostomy. Most significant was the failure of the diminished level of prothrombin to rise even after the parenteral administration of vitamin K on two occasions (see Fig. 1). This suggested liver damage explainable on the basis of a hepatitis rather than as a result of obstruction of the common duct.

Roentgenograms taken on the forty-fourth day after the first operation showed a well-functioning esophagogastrostomy stoma. The patient was discharged two days later with the cholecystostomy wound still draining a small amount of bile. The subsequent course was favorable save for recurrence of infection in the thoracotomy wound two months after discharge at which time the buried silver wire sutures were removed. Again, one year after operation, a localized empyema with abscess of the chest wall occurred in the same region, necessitating drainage.

At the time of this communication, four years after esophagogastrostomy, the patient shows no evidence of residual disease.

Included among the points of interest in this case are:

1. Failure to diagnose accurately by x-ray examination the presence of carcinoma at the cardiac end of the stomach. It is well known that lesions in this region may be overlooked and it is only with repeated x-ray examinations and the use of additional diagnostic aids including esophagoscopy and gastroscopy that these lesions may be diagnosed at an early stage.

2. The presence of a polyserositic reaction that had all but obliterated the pleural and peritoneal cavities. This offered such technical difficulties that abandonment of attempted resection might have been considered prudent.

3. The massive involvement by carcinoma of lymph nodes in the gastrohepatic omentum and attachment of the stomach to the liver. This rendered the operability of the lesion even more doubtful, but, that it was justified is evidenced by the fact that four years after operation there is no evidence of recurrence.

4. The occurrence of jaundice five days after esophagogastrostomy. This seemed best explained on the basis of partial obstruction of the common duct by upward traction on the stomach resulting in conspicuous distention of the gall bladder, and, in addition, associated hepatitis that produced low levels of plasma prothrombin that failed to respond to vitamin K administered parenterally.

5. The recurrence of infection in the chest wall with localized empyema, as late as one year after operation. While a small segment of a silver wire stay suture remains in the chest wall the empyema apparently was not associated with this.

MALIGNANT TUMORS OF THE THYROID GLAND

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THIS small series of malignant tumors of the thyroid gland is being reported in order to point out the fact that such lesions are uncommon in a general hospital outside of the goiter belt and to emphasize some points in their clinical manifestations, microscopic characteristics, and treatment.

INCIDENCE

The only large series of cases which have been published in the United States literature have been from the Mayo Clinic, the Lahey Clinic, and the Cleveland Clinic, where the proportion of operations upon the thyroid gland to other operations is larger than in most of the other institutions in this country. The numbers of patients with malignant tumors of the thyroid gland operated upon, followed, and reported from these clinics are as follows: From the Mayo Clinic in 1938 by Pemberton,[19] 464 cases; from the Lahey Clinic in 1940 by Lahey and associates,[16] 231 cases; and from the Cleveland Clinic in 1941 by Portmann,[20] 147 cases. However, from the Bellevue Hospital (3,082 beds) in New York City, Rosh and Raider[21] stated in 1945 that only 64 malignant tumors of the thyroid gland had been seen in their radiation therapy department from 1924 to the time of writing of their report. From the Memorial Hospital (223 beds) in New York City Haagensen,[9] in 1931, reported 30 patients who had been treated by radiation therapy only. Coller,[1] in 1929, reported 90 patients with malignant epithelial neoplasms who had been operated upon from 1912 to 1927 in the University of Michigan Hospital (899 beds) at Ann Arbor, Mich., which is in the goiter belt. In 1947 Horn and associates[12] from the University of Pennsylvania Hospital (697 beds) reported 71 patients with thyroid carcinoma observed from 1933 until the time of writing of the report.

Over a period of twenty-two years, during which time 122,633 patients have been admitted to the Vanderbilt University Hospital (340 beds), there have been only 23 patients admitted with malignant disease of the thyroid gland. Twenty-two of these patients were operated upon and one died and was subjected to autopsy without operation upon the thyroid gland. During this same period there have been 399 patients operated upon for carcinoma of the breast. In the surgical pathology laboratory 1,168 specimens of thyroid glands have been examined, the 22 specimens of malignant tumors of the thyroid gland thus giving a percentage of 1.88 of the thyroid lesions upon which operation had been performed.

Age.—The ages of these patients ranged from 13 to 70 years (Table I).

Sex.—In this series there were 6 male and 17 female patients.

CLASSIFICATION

Malignant tumors of the thyroid gland have never been satisfactorily classified but that same statement holds true for other malignant neoplasms,

TABLE I. AGE IN YEARS OF TWENTY PATIENTS IN FOLLOW-UP STUDY

AGE (YR.)	TOTAL CASES	PATIENTS ALIVE	PATIENTS DEAD
13	1	1	0
21-30	3	2	1
31-40	4	1	3
41-50	5	4	1
51-60	4	0	4
61-70	3	1	2
Total	20	9	11

Ages of two patients with carcinoma of the thyroid seen within the past year were 58 and 59 years. Age of one patient who died in the hospital without operation upon the thyroid gland was 65 years. These three patients are not included in this table.

for example, those of bone. The tumors in this series could be placed in one of the following categories:

1. Papillary adenocarcinoma
2. Adenocarcinoma
3. Alveolar adenocarcinoma
4. Alveolar carcinoma
5. Giant-cell carcinoma
6. Squamous-cell carcinoma
7. Sarcoma

The first four types are not completely distinct, that is, they merge gradually from one morphologic type to another. They could be tabulated thus:

1. Adenocarcinoma
   (a) Papillary
   (b) Purely acinar (not papillary or alveolar)
   (c) Alveolar
2. Alveolar carcinoma

Papillary Adenocarcinoma (Figs. 1, 2, and 3).—Portions of such tumors are papillary and other portions show definite acinar formations. In some areas of the neoplasm colloid is present in the acini. The proportion of papillary areas to acinar areas varies in different tumors and in different sections of the same tumor from almost purely papillary to almost purely acinar. In one of the tumors (Fig. 2) the areas of acinar formation were minimal but, since they did exist, it was felt unnecessary to use another class, that is, papillary carcinoma.

Adenocarcinoma (Figs. 4 and 5).—Two of the tumors were true adenocarcinomas and the qualifying adjective, papillary or alveolar, was unnecessary. Both of these tumors contained areas of cells which were well enough differentiated to secrete colloid.

Alveolar Adenocarcinoma (Figs. 6, 7, 8, and 9).—The word "alveolus" is the diminutive form of the Latin word *alveus* which means tray, basin, or trough. Alveolus also means air sac of the lung (Dorland[7]). It is probably because of one of these meanings that tumors said to show cells growing in alveolar fashion are understood to be those which grow in groups separated by septa of connective tissue. Ewing[4a] stated that, "Small alveolar carcinoma is a specific

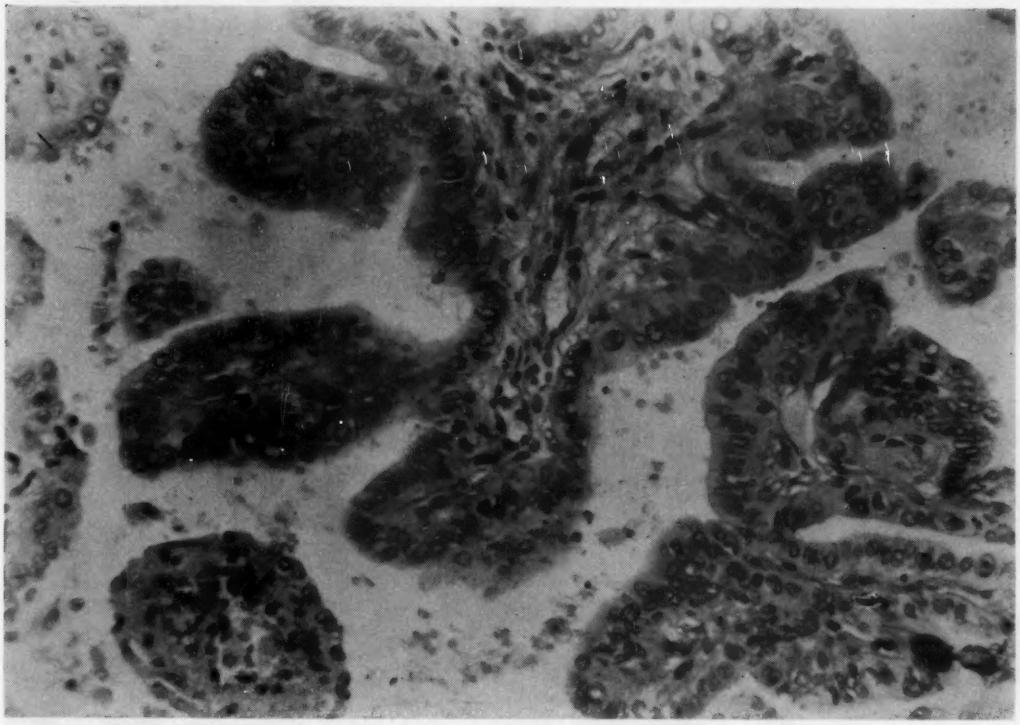

Fig. 1 (Surg. Path. No. 4915).—Papillary adenocarcinoma; this field is almost purely papillary.

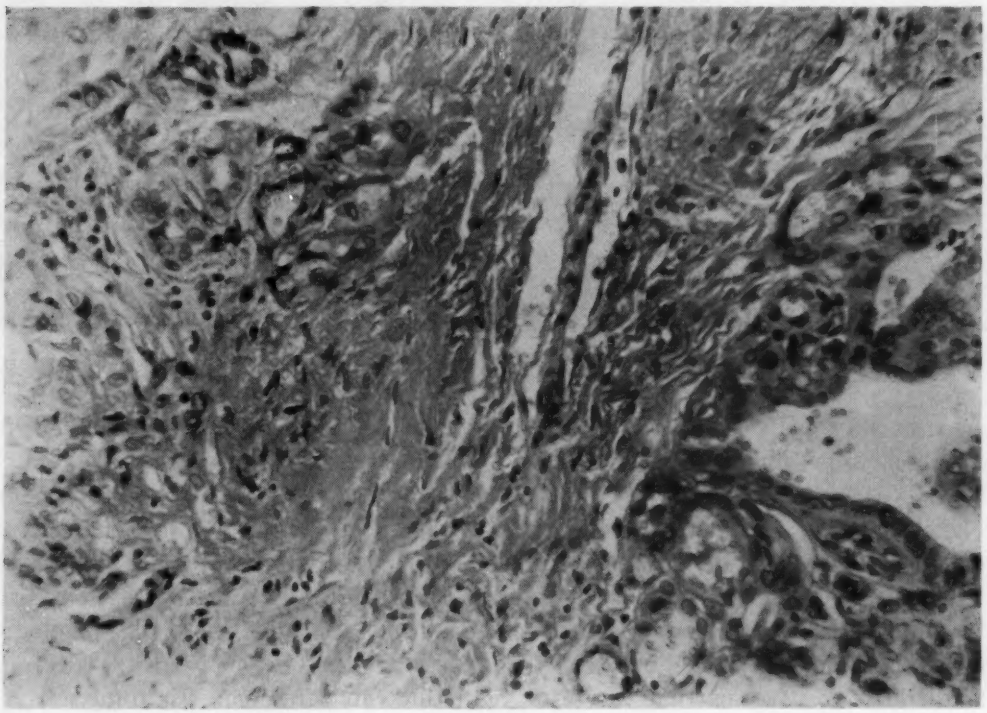

Fig. 2 (Surg. Path. No. 4915).—Papillary adenocarcinoma, same patient as Fig. 1. This field shows both papillary and glandular areas.

term which may properly designate a carcinomatous structure in which the cells appear in small groups supported by a moderate amount of connective tissue. . . . Large alveolar carcinoma equally well designates a similar structure in which the cell groups are large, but still well defined.'' This type of tumor of the thyroid shows acinar formation, but in some areas the cells are seen in groups or sheets without showing a central lumen. It is in this class that we have placed the tumors formerly classified as Hürthle cell carcinomas. There is no positive proof, as pointed out by Wilensky and Kaufman,[25] of the existence of the interfollicular thyroid cells described by Hürthle.[13] Hürthle did not describe a tumor arising from such cells but Ewing[3] in his third edition of *Neoplastic Diseases* stated that in two tumors which he had seen ''the acidophile cells might represent hypertrophic Hürthle cells of the thyroid alveoli.'' However, in his fourth edition[4b] he stated that, ''assumption of a special anatomical origin of this tumor is unnecessary.'' The term ''small alveolar, large cell'' *(kleinalveolare, grosszellige)* carcinoma sometimes applied to this tumor (Ewing[4b]) was originated by Langhans.[17] If these tumors are parathyroid in origin as suggested by Eisenberg and Wallerstein,[2] there should be evidence of hyperparathyroidism; such manifestations were not present in their patient and have not, to our knowledge, been reported. In addition, there is morphologic evidence (Fig. 9) that the tumor tends to reproduce the cells of the thyroid acini. Hence it seems that the term ''Hürthle cell carcinoma'' is unnecessary.

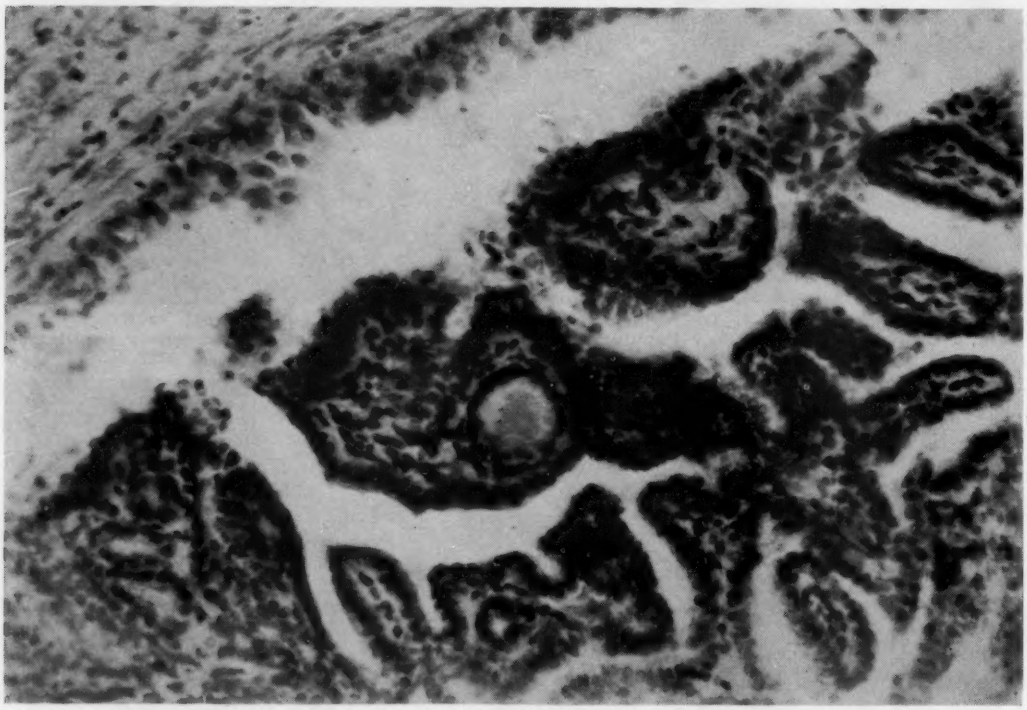

Fig. 3 (Surg. Path. No. 1511).—Papillary adenocarcinoma, an acinus containing colloid is shown.

Alveolar Carcinoma (Fig. 10).—In the alveolar carcinoma the cells grow in sheets separated by connective tissue septa. No acini are present in the tumor.

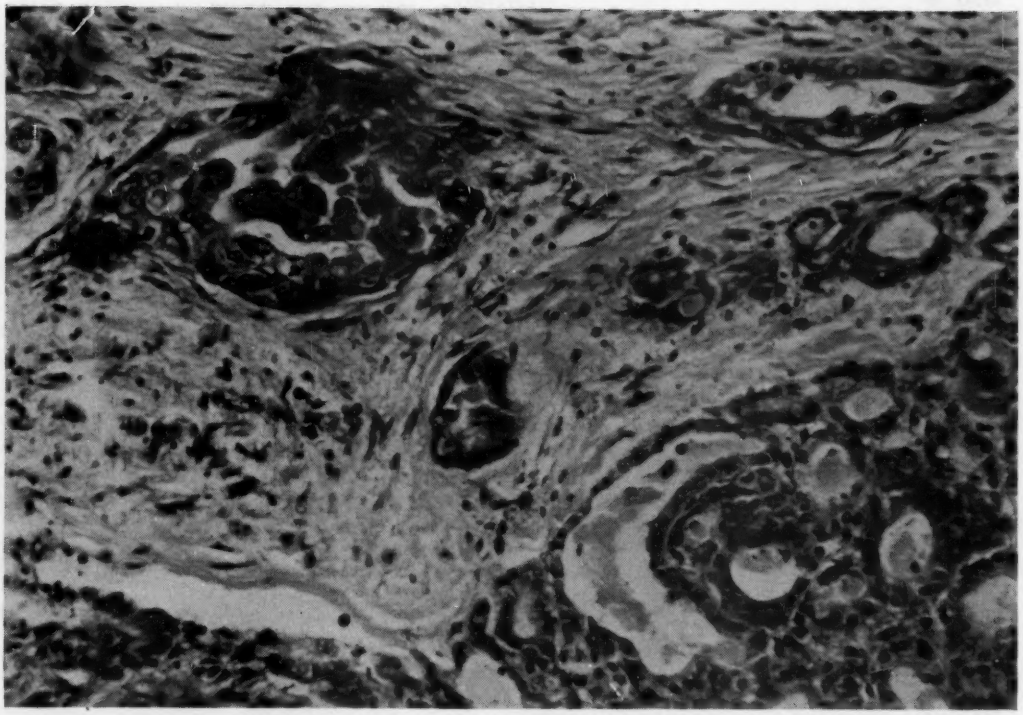

Fig. 4 (Surg. Path. No. 15536).—Adenocarcinoma.

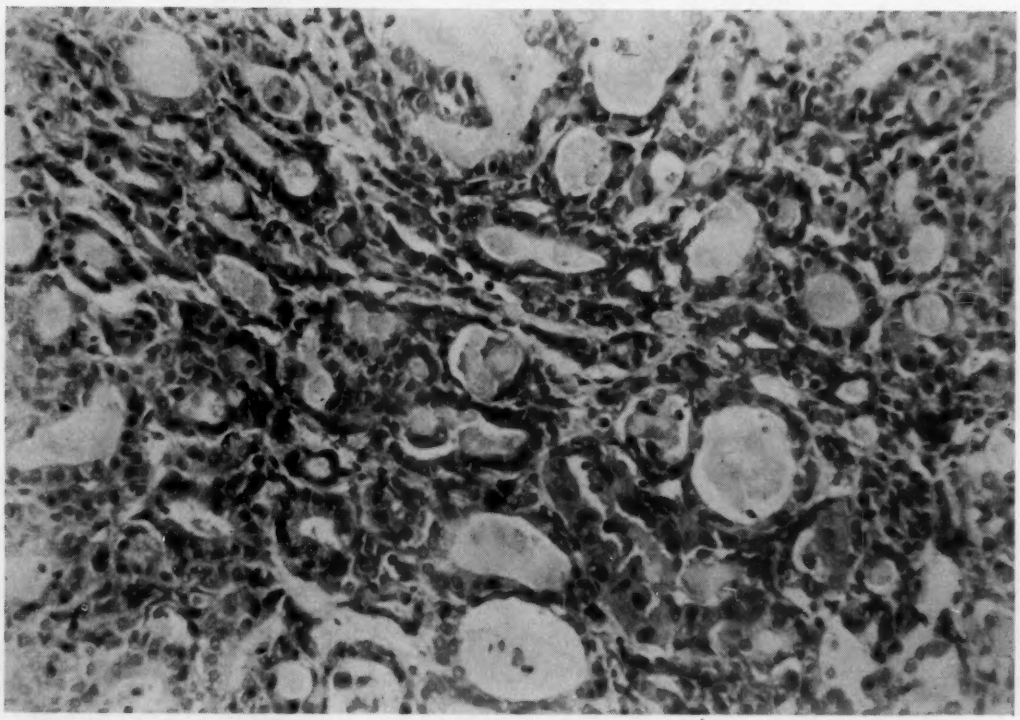

Fig. 5 (Surg. Path. No. 15536).—From same patient as Fig. 4. Areas of hyperplasia are seen; patient had preoperative treatment with Lugol's solution.

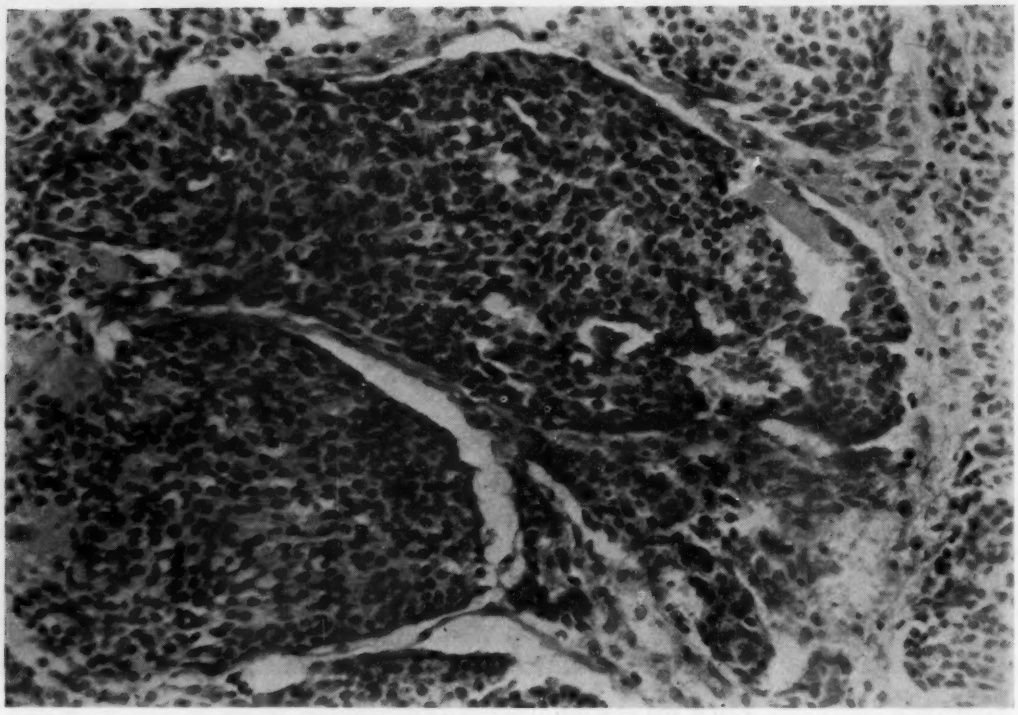

Fig. 6 (Surg. Path. No. 15930).—Alveolar adenocarcinoma. In this field most of the cells are seen in the form of sheets without glandular formation.

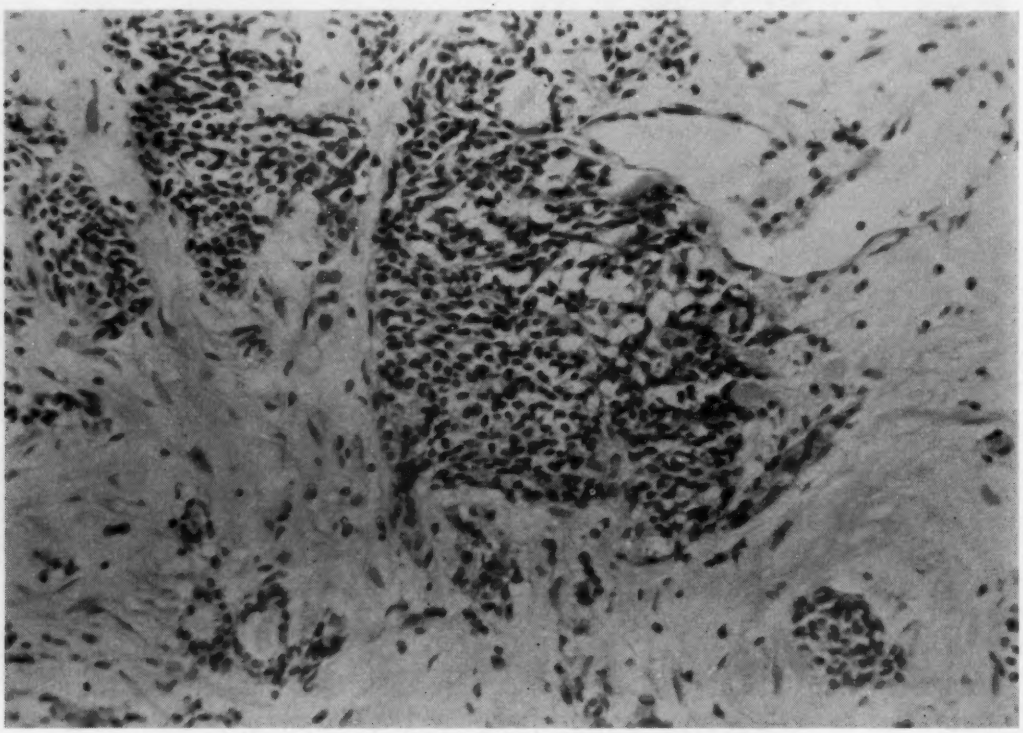

Fig. 7 (Surg. Path. No. 15930).—Alveolar adenocarcinoma, from same patient as Fig. 6. Areas of glandular formation are present as well as cells growing in alveolar fashion.

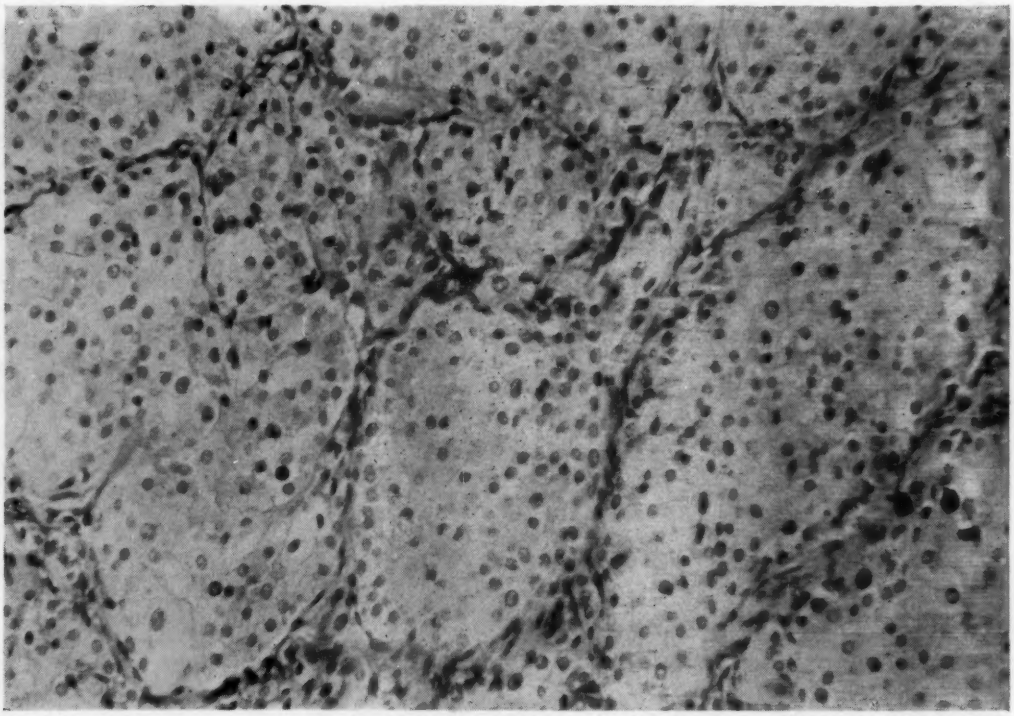

Fig. 8 (Surg. Path. No. 14435).—Alveolar adenocarcinoma. This is the type of tumor which some observers call Hürthle cell carcinoma. This field shows alveolar areas.

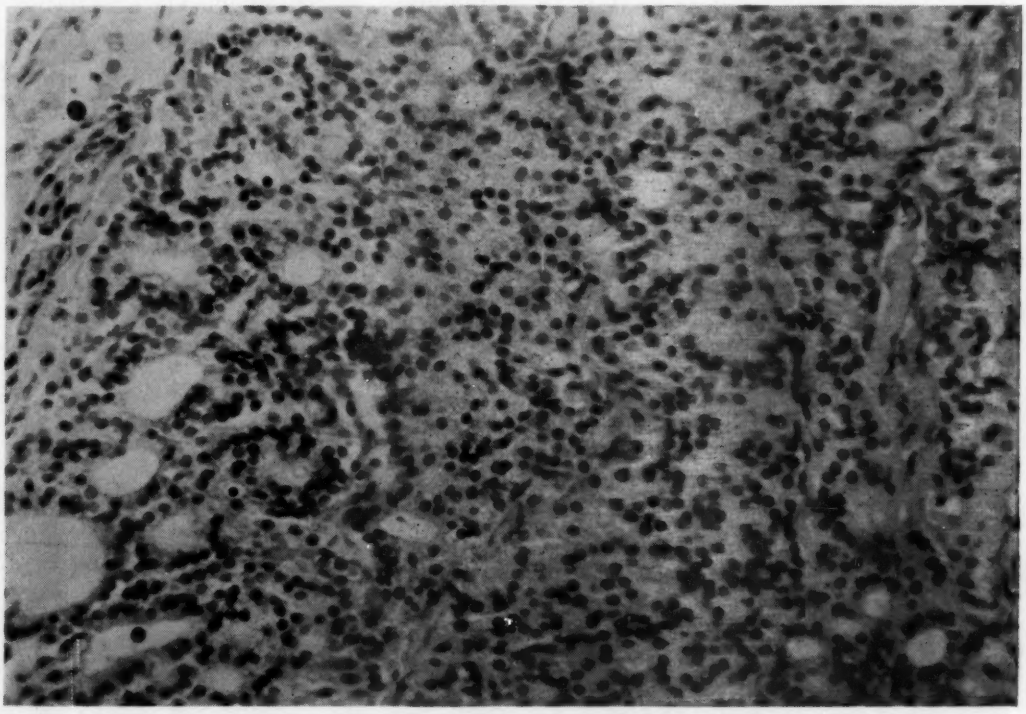

Fig. 9 (Surg. Path. No. 14435).—Alveolar adenocarcinoma, from same patient as Fig. 8. Glandular formation is shown.

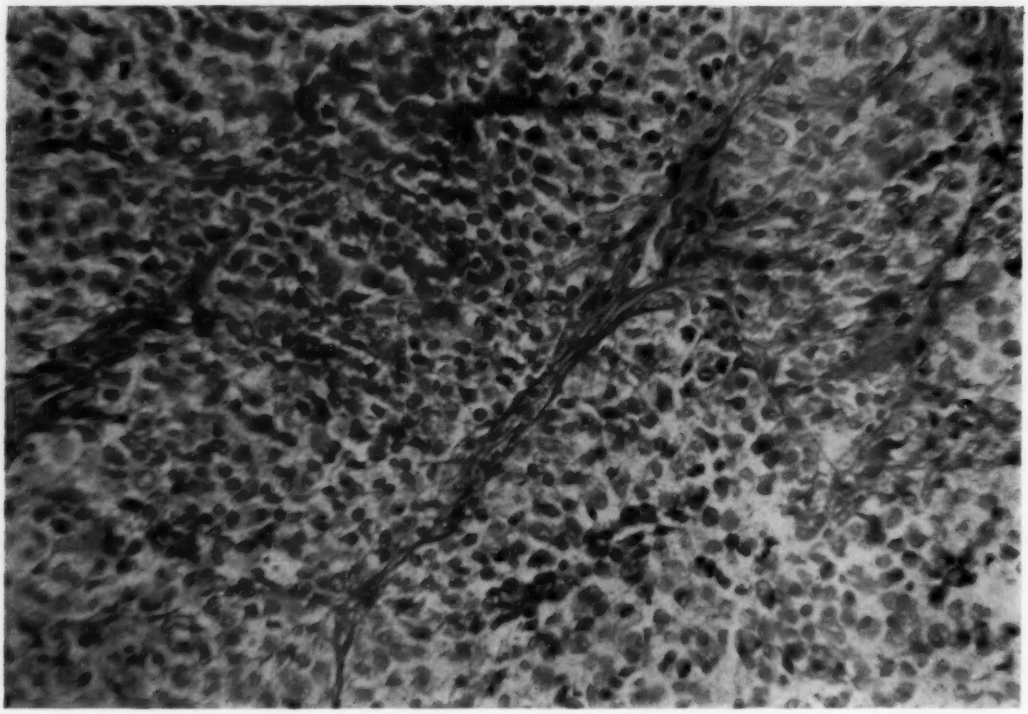

Fig. 10 (Surg. Path. No. 5226).—Alveolar carcinoma. Cells growing in sheets separated by connective tissue septa.

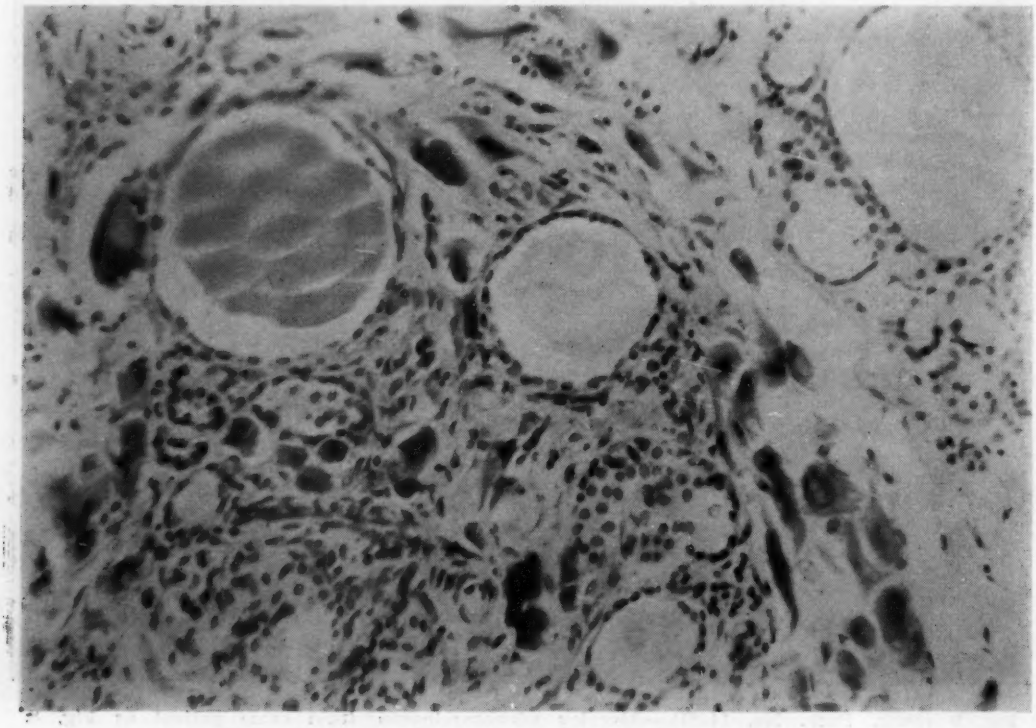

Fig. 11 (Gen. Path. No. V-47-62).—Giant-cell carcinoma.

Giant-Cell Carcinoma (Figs. 11, 12, and 13).—Giant-cell carcinoma is so poorly differentiated that the cells are hardly recognizable as having originated from thyroid epithelium. The predominating cell is the malignant tumor giant cell. This tumor has previously been called carcinoma-sarcoma but it appears to be really a carcinoma. In one such case poorly formed acini were present (Fig. 13).

Squamous-Cell Carcinoma (Fig. 14).—Squamous-cell carcinomas show the same microscopic characteristics in the thyroid as do such tumors arising in the skin. Their origin has not been definitely determined but it seems more likely to be from remnants of the thyroglossal duct (Means[18]) than from glandular thyroid tissue by metaplasia as suggested by Jaffe.[14]

Sarcoma (Fig. 15).—The single sarcoma in this series was, on the basis of morphology, a fibrosarcoma. The presence of spindle cells and connective tissue fibrils indicated that the tumor was not of epithelial origin.

COMMENT ON OTHER TERMS

There was no tumor in this series which necessitated including the class of small cell carcinoma. Although this type of tumor may exist, we agree with Graham[6] that there is a danger of applying this term to lymphosarcomas. Furthermore, the photomicrographs of some of these tumors so classified by Ewing[4c] and Foot[8] lead us to believe that they could be classified as alveolar carcinomas.

The word "scirrhous" means hard and was useful in the description of gross pathologic specimens before examination of stained sections by the microscope was possible. At the present time it seems unnecessary to use this word in the classification of thyroid carcinomas.

The term "malignant adenoma" is one which could be abolished. Adenoma means "benign epithelial tumor with gland-like structure" (Dorland[7]). Hence, this combination of words means "malignant benign epithelial tumor. . . ." It seems preferable to call the tumor a carcinoma if it is malignant. If there is evidence on examination of the gross specimen or the section of its having arisen in an adenoma, that fact may be stated parenthetically.

The occurrence in the lateral portion of the neck of the so-called lateral aberrant thyroid may be explained on an embryologic basis (Weller[24]). However, such a tumor may be a metastasis from a thyroid carcinoma. In one case in point (Figs. 6 and 7) in this series the patient was subjected to excision of the lateral mass. When this procedure was completed, the thyroid lobe on the same side of the neck was examined and found to be quite hard. There was no connection demonstrable between the lateral mass and the thyroid gland. A portion of the latter was excised and microscopic sections showed tumor tissue of the same type from both sites. The lateral mass showed lymphoid tissue around the periphery. We agree with King and Pemberton[15] that the so-called aberrant thyroids usually are lymph node metastases from thyroid carcinoma. If microscopic section reveals tissue suggestive of thyroid carcinoma, the thyroid gland should be explored. If exploration reveals tumor, lobectomy should be done or as much of the tumor as possible should be removed.

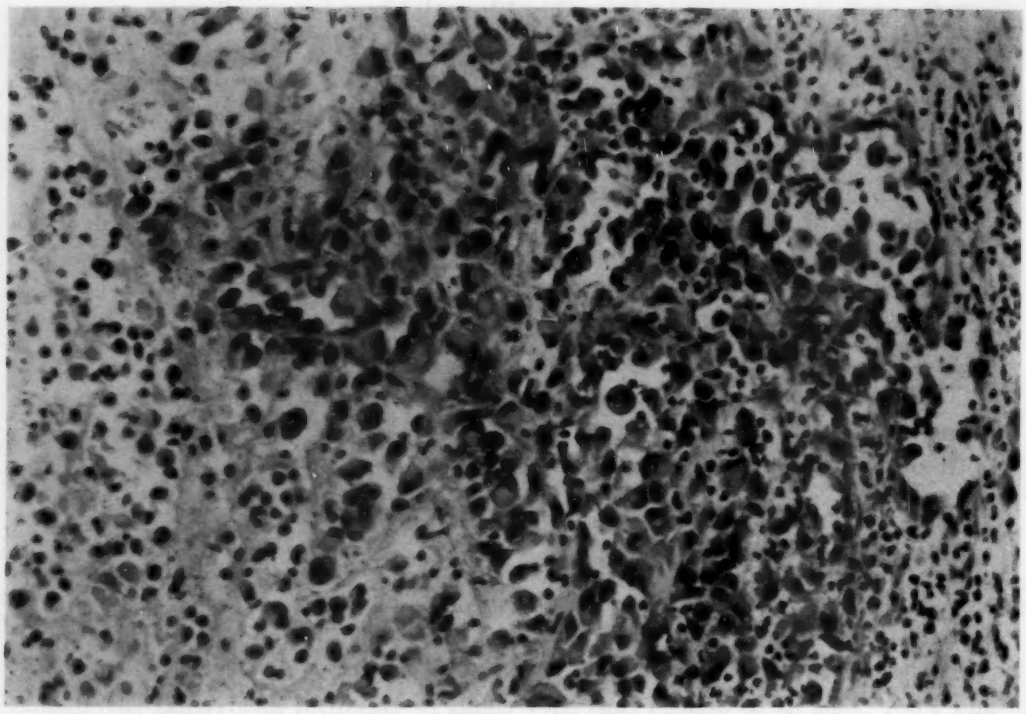

Fig. 12 (Surg. Path. No. 12039).—Giant-cell carcinoma.

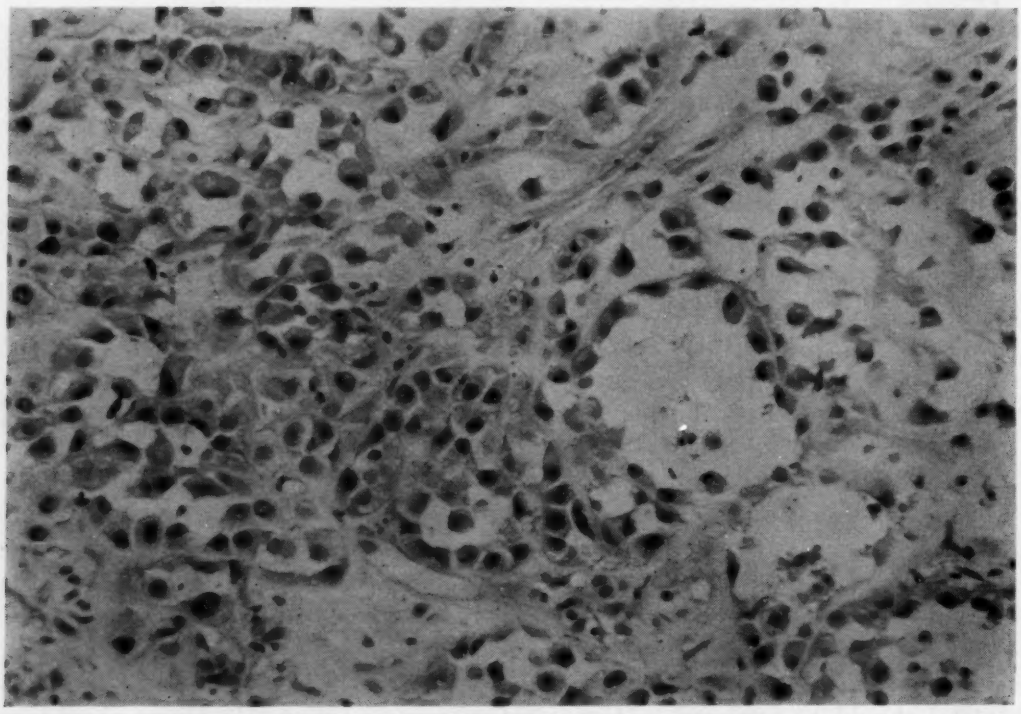

Fig. 13 (Surg. Path. No. 12039).—From same patient as Fig. 12; acinar formation.

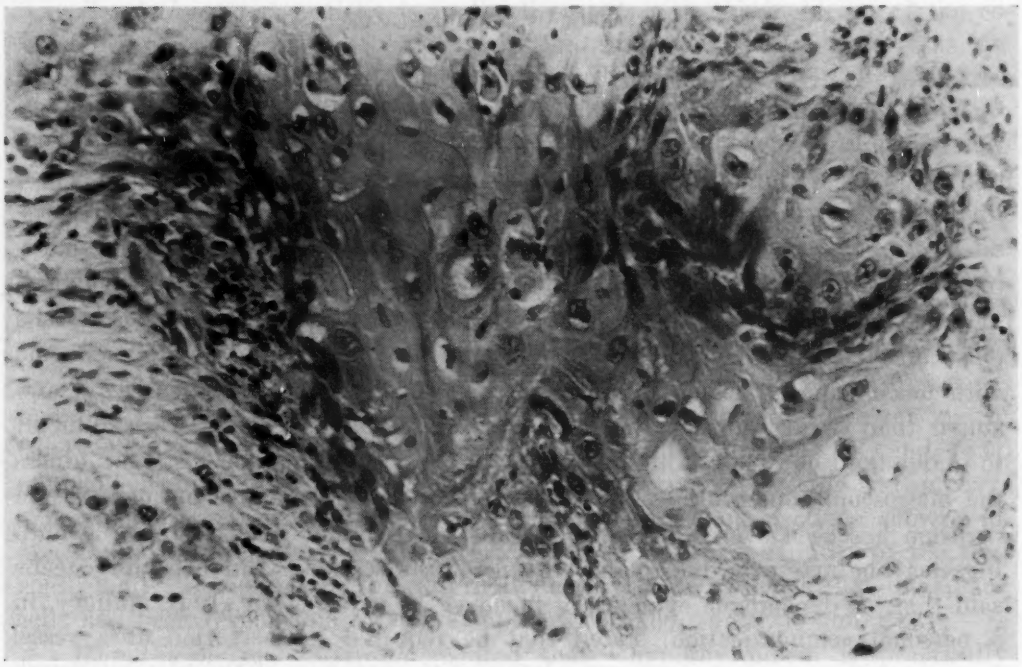

Fig. 14 (Surg. Path. No. 14761).—Squamous-cell carcinoma.

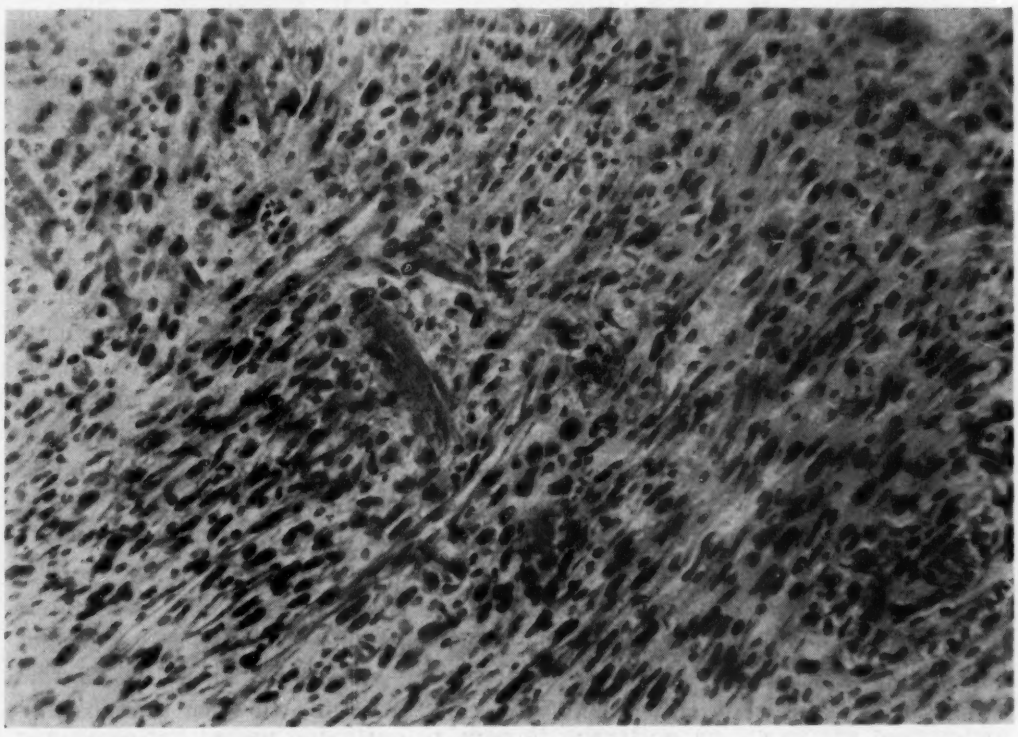

Fig. 15 (Surg. Path. No. 4613).—Fibrosarcoma.

CRITERIA OF MALIGNANCY

While actual blood vessel invasion as discussed by Graham[5] is a criterion of malignancy, its existence is extremely difficult to prove. If upon examination of the gross specimen, one finds tumor in a vein and confirms this observation upon microscopic examination, there can be no doubt that the tumor has invaded a blood vessel. However, in the literature there have apppeared photomicrographs purportedly showing blood vessel invasion which are not convincing. Tumor cells surrounded by connective tissue strands resemble neoplasm in an endothelial lined vessel. Tumor in acini which contain red blood cells may cause confusion. In 1931 Warren[23] reported thirty-two cases of adenoma with blood vessel invasion followed for two and one-half to seven years and stated that twenty-nine of the patients were living and well. It is difficult to understand how such a high survival rate is possible in such instances unless the microscopic observations are inaccurate or the importance of blood vessel invasion has been overemphasized. Means[18] stated that such microscopic findings may be artefacts due to the cutting of the section. Furthermore, Means said that, as dependable evidence of blood vessel invasion Dr. T. B. Mallory, in a personal communication, stated that he required "penetration of a vessel large enough to possess some musculature with extension of the tumor through this muscularis."

In carcinoma showing evidence of origin in adenoma, there are signs of malignancy other than blood vessel invasion. These signs are those of malignancy in carcinoma of other sites such as mitoses, lack of differentiation, variation in size, shape, and staining qualities of the cells, and the invasion of the capsule and adjacent tissues. It is quite rare for a tumor to show unquestionable blood vessel invasion without showing other criteria of malignancy.

CLINICAL MANIFESTATIONS

Chief Complaint.—In this series there were nine patients alive four to eighteen years after the diagnosis of carcinoma was made. These nine patients complained of goiter but the presence of the goiter was not the chief reason for seeking medical advice in any one of them. The chief reasons for consulting physicians were rapid increase in the size of the goiter (three patients); slow increase in the size of the goiter (two patients), along with pressure symptoms in one of these two; rupture of a mass in the neck (one patient); symptoms of hyperthyroidism (one patient); weight loss (one patient); sleepiness and, six months later, the presence of a cervical lymph node (one patient).

Duration of Goiter.—Seven of the nine surviving patients had goiters which had been present for periods varying from four to thirty years. Seven of the eleven patients who died had goiters which had been present for four to twenty-five years. The only conclusions that can be drawn from this observation are that an enlarged thyroid is more likely to be the site of carcinoma than a thyroid of normal size and that the duration of the goiter had no bearing on the prognosis.

Hyperthyroidism.—Reports in the literature give the incidence of the coexistence of cancer of the thyroid gland and manifestations of toxicity as low as 3 per cent (Herbst[11]) and as high as 50 per cent (Simpson[22]). In this series there were four patients who had elevations of the basal metabolic rate, but only two in whom the diagnosis of hyperthyroidism was not open to question. In one man (Fig. 5), the clinical manifestations of toxic goiter were typical and included fatigability, sweating, dyspnea on exertion, weight loss of twenty-five pounds in three months, tachycardia, tremor, slight exophthalmos, and a basal metabolic rate of plus 60. Lugol's solution was administered daily for thirteen days and then a subtotal thyroidectomy was done. Microscopic sections showed the characteristic findings of diffuse toxic goiter after iodine therapy and also an adenocarcinoma. In one woman (Surg. Path. No. 1511) the manifestations included nervousness, increased appetite, sweating, palpitation, weight loss of thirty-seven pounds in three years, tremor, slight exophthalmos, and basal metabolic rate of plus 57. Lugol's solution was given daily for sixteen days and then subtotal thyroidectomy was done. Microscopic sections showed an alveolar adenocarcinoma and definite hyperplasia of the remainder of the thyroid gland. In neither of these individuals was there evidence that the tumor cells had been responsible for the symptoms and signs of toxic goiter.

Hypothyroidism.—Simpson[22] stated that "hypothyroidism is practically unknown even in the most massive growths." Means[18] stated that "hypothyroidism from malignancy is in our experience practically nonexistent." In one patient in this group, a male student, the symptoms of sleepiness and inability to concentrate upon studies caused a physician to determine the basal metabolic rate which was minus 32. He was given 0.15 Gm. of thyroxin daily for six months at which time lymph nodes appeared in the posterior cervical region. As the operation consisted only of excision of a lymph node and of a small amount of thyroid gland for microscopic study, it is impossible to state the degree of destruction of functioning thyroid tissue that had occured. In the biopsy specimen no normal thyroid was present.

Consistency of the Tumors.—Physical examination of these twenty-two patients showed that twelve of the tumors were hard, eight were firm, and two were soft. Carcinoma of the thyroid is usually described as being hard, but in this small series, only slightly more than one-half of the tumors were hard.

Origin in Adenoma.—Graham[5] found that 92.4 per cent of the thyroid carcinomas which he studied arose in adenomas. In only seven of our patients did gross and microscopic studies reveal such an origin.

TREATMENT AND RESULTS

Lahey and associates[16] stated that "surgery finds its most satisfactory place, of course: first, in the prophylactic removal, while the tumor is still benign, of the discrete tumors of the thyroid gland in which malignancy may later arise." Furthermore, since the diagnosis of carcinoma in this series was not suspected before operation or even at operation, in six of the twenty-two patients being reported, excision of a single nodule is certainly justifiable because of the fact that such a nodule may already be malignant when first observed.

In the series reported by Pemberton[19] of 464 cases of thyroid cancer there were 259 five-year survivals. Lahey and co-workers[16] stated the percentages of five-year survival rate for each type of tumor but did not state the number of five-year survivals. Portmann[20] stated that 42 of 147 patients with thyroid cancer were alive and well five years after the diagnosis had been established.

Two of the patients in this series were operated upon within the past year and are not included among the twenty patients in the follow-up study. Nine of these twenty patients are alive, the survival time ranging from four to twenty years (Table II). Only one of the nine subjects has a recurrence at present.

The results in relation to the type of tumor are shown in Table III. Half of the patients who had papillary adenocarcinoma are alive, one with recurrence. Both of the individuals who had adenocarcinoma are alive and well. One-third of the patients who had alveolar adenocarcinoma are alive and well. In the single case of squamous-cell carcinoma in this series, the tumor arose in the left lobe of the thyroid and had involved the regional lymph nodes. The patient was subjected to removal of the left lobe of the thyroid gland, excision

TABLE II

SURG. PATH. NO.	TUMOR COMPLETELY REMOVED	TUMOR CONFINED TO THYROID	X-RAY TREATMENT	RESULT	INTERVAL
Papillary Adenocarcinoma					
1511	Yes	Yes	No	Alive	18 yr.
2819	No	Yes	Yes	Dead	6½ yr.
4915	No	No	Yes	Alive	14 yr.
5326	No	No	Yes	Alive	14 yr.
11471	No	No	Yes	Dead	6 yr.
15470	No	No	Yes	Dead	2½ yr.
16926	No	No	Yes	Alive*	4 yr.
19441	No (biopsy only)	No	No	Dead	11 mo.
Adenocarcinoma					
10996	No (biopsy only)	No	Yes	Alive	8 yr.
15536	Yes	Yes	No	Alive	5 yr.
Alveolar Adenocarcinoma					
6047	No	No	Yes	Dead	1 yr. 10 mo.
8282	No	No	Yes	Dead	1 yr. 9 mo.
14435	Yes	Yes	No	Alive	5 yr.
15930	No	No	Yes	Alive	4 yr.
16534	Yes	No	No	Dead	2 yr. 9 mo.
17294	No	No	No	Dead	4 mo.
Alveolar Carcinoma					
5226	No	No	Yes	Dead	3 mo.
Giant-Cell Carcinoma					
12039	No	No	No	Dead	3 mo.
Squamous-Cell Carcinoma					
14761	No	No	Yes	Alive	5 yr.
Fibrosarcoma					
4613	No	No	No	Dead	1 mo.

This table shows the results in relation to the type and extent of tumor, to the completeness of its removal, and to whether or not roentgen-ray therapy was administered.

*With recurrence.

TABLE III

TYPE OF TUMOR	NUMBER OF PATIENTS		
	TOTAL	ALIVE	DEAD
Papillary adenocarcinoma	8	4	4
Adenocarcinoma	2	2	0
Alveolar adenocarcinoma	6	2	4
Alveolar carcinoma	1	0	1
Squamous-cell carcinoma	1	1	0
Giant-cell carcinoma	1	0	1
Sarcoma	1	0	1
Total	20	9	11

This table shows the results in relation to the type of tumor. Not included are a case of adenocarcinoma and one of papillary adenocarcinoma observed within the past year and a patient with giant-cell carcinoma who died without operation upon the thyroid gland.

of the lymph nodes, and roentgen-ray therapy. She is alive and without evidence of recurrence five and one-half years after operation. The patients who had alveolar carcinoma, giant-cell carcinoma, and fibrosarcoma are dead.

Of the thirteen patients in whom the diagnosis of malignant disease was made positively or tentatively before operation, four are alive and well (Table IV). One is alive with recurrence and eight are dead. The five surviving patients received postoperative x-ray therapy as did five of the eight individuals who died. Of the three patients in whom the diagnosis of malignancy was first suspected at operation, two died and one is alive and well. There were four patients in whom the diagnosis of carcinoma was not made until the microscopic section was seen. Three of these patients are alive and well. One died, but since death occurred at home, supposedly from cerebral hemorrhage, it is impossible to state whether or not the carcinoma was responsible for death. None of these four patients received roentgen-ray therapy.

TABLE IV

DIAGNOSIS OF CANCER	NUMBER OF CASES		
	TOTAL	ALIVE	DEAD
Suspected before operation	13	5	8
Suspected at operation	3	1	2
Not suspected until microscopic sections were seen	4*	3	1

*These four patients were the only ones in whom the tumor was completely removed.

The tumor was completely removed in only three of the surviving patients (Table II). Hence in six, or two-thirds, of the living patients removal of the tumor was incomplete and in one of the six only a biopsy was done. In only one of the patients who died was the tumor thought to have been completely extirpated. The four patients in whom complete removal of the tumor was done are the same four in whom the diagnosis of carcinoma was not made until the microscopic sections were seen. Two patients were seen within the past year in whom the diagnosis of carcinoma was not made until the microscopic sections were seen and were not irradiated. It is felt that if examination of the gross specimen and microscopic sections lead one to believe that all the tumor has been removed, irradiation should not be given.

Excision of recurrences, if possible, seems justified by the course of two patients in this series. One of these patients had a papillary carcinoma extending into the neck muscles and was subjected to right lobectomy and roentgen-ray therapy. Three months later a nodule to the right of the scar was excised and found to exhibit the same microscopic characteristics as the original tumor. She was given more x-ray therapy and is alive and well fourteen years after operation. The second patient had an alveolar adenocarcinoma which had not invaded the surrounding structures. A left lobectomy was done with almost complete excision of the tumor and x-ray therapy was not given. A recurrence, showing the same type of tumor, was excised four and one-half years later and although roentgen-ray therapy was not given, she is alive and well one and one-half years after excision of the recurrence.

The length of time from the establishment of the diagnosis until the death of the eleven patients is shown in Table II. This period ranged from one month to six and one-half years. The duration of life after the diagnosis of cancer was made was six years in one patient and six and one-half years in another. The average survival time of these eleven patients was twenty-five months. The survival time of the six subjects, now dead, who received roentgenologic therapy ranged from 21 to 78 months and averaged 37½ months. The period of survival of the five patients who died without roentgen-ray therapy ranged from one to twenty-four months and averaged ten months.

In this clinic at the present time the usual procedure in treatment of carcinoma of the thyroid by roentgen-ray is as follows:

Employing 20 ma. at 200 kv. with target-skin distance of 50 cm. and filtration of 0.5 mm. of copper and 1 mm. of aluminum, doses of 400 r. are given to one field per day. Two fields are employed and each is given a total of approximately 2,800 r depending upon skin tolerance.

CONCLUSIONS

1. Malignant tumors of the thyroid gland are uncommon in general hospitals outside the goiter belt.

2. As determined upon physical examination, thyroid cancers are not always hard in consistency; some are firm and some are soft.

3. A single nodule in the thyroid gland should be excised because it may be malignant at the time it is first observed.

4. Microscopic observation of tumor cells in blood vessels is not necessary for the diagnosis of carcinoma of the thyroid gland and is not always a reliable criterion of malignancy.

5. Carcinoma of the thyroid so extensive as to preclude operation other than a biopsy should not be considered hopeless inasmuch as such a patient is herein reported alive and without recurrence eight years after diagnosis and x-ray therapy.

6. Recurrent malignant nodules in the thyroid region should be removed.

7. The clinical manifestations of hypothyroidism may be present in a patient with carcinoma of the thyroid gland.

The sections of the tumors of our surviving patients were reviewed by Dr. E. W. Goodpasture, Professor of Pathology, Vanderbilt University School of Medicine, and Dr. N. C. Foot, Professor of Surgical Pathology, Cornell Medical College. They confirmed the diagnosis of carcinoma in every instance herein reported.

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ILIAC LYMPHADENOPATHY AS A CAUSE OF URETERAL OBSTRUCTION

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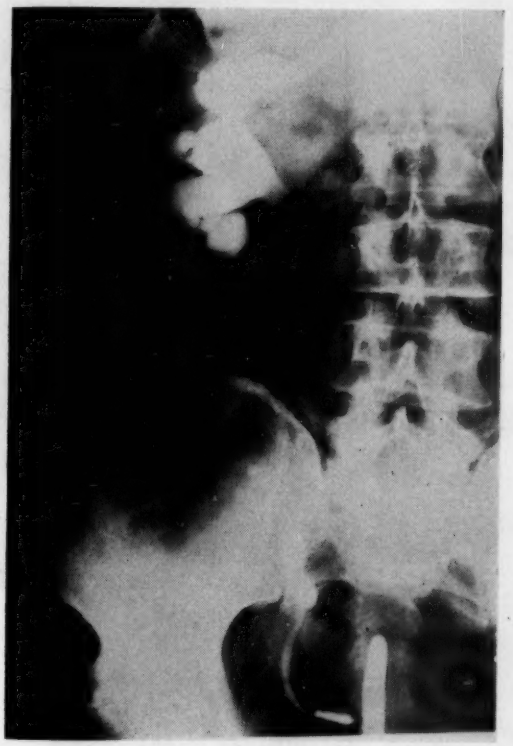
CURRENT urologic textbooks and available literature upon the subject omit entirely, or merely mention, iliac lymphadenopathy in their discussions of the various etiologic factors which may cause ureteral obstruction. In considering diagnostically the patients with ureteral obstruction most of these authors accept enlarged lymph nodes as a cause only where they are large enough to be clinically palpable or to cause displacement of regional viscera. Recently, however, five patients have been studied in whom ureteral function was found compromised by only moderately enlarged iliac lymph nodes. In reviewing these cases critically the similarity of the clinical, laboratory, and pyelographic studies led us to conclude that this type of ureteral obstruction constitutes a definite diagnostic entity.

CASE HISTORIES

CASE 1 (N.Y.H. No. 253117).—M. R., a 56-year-old man, was admitted to the hospital in 1942 complaining of pain in the right flank. The general physical and routine laboratory examinations revealed no abnormality. Although the left upper urinary tract appeared normal, a right hydronephrosis was shown on intravenous pyelography. Catheters could be introduced easily up the right ureter for 9 cm., but no farther. Using the Woodruff technique a retrograde pyeloureterogram (Fig. 1) demonstrated hydronephrosis and hydroureter down to the pelvic brim (the same level as the obstruction noted by catheterization from below), where an abrupt narrowing occurred. The ureter within the pelvis appeared normal. At exploration, the ureter was freed from a mass of matted lymph nodes, some of which were three-fourths the size of a hen's egg, located over the bifurcation of the common iliac artery. The pathologic examination of several of these nodes demonstrated Hodgkin's disease, which was not preoperatively suggested by any findings. Radiotherapy proved to be only mildly effective since the patient died fourteen months later of the generalized disease.

CASE 2 (N.Y.H. No. 267639).—V. G., a 49-year-old man, was admitted to the hospital in 1942 complaining of pain in the right flank and fever. Two years previously a perineal resection of the rectum for cancer had been done, but the patient had been asymptomatic until five days before admission. General physical and laboratory examinations revealed no abnormality except evidences of sepsis and a tender right kidney. Studies of the left upper urinary tract were normal, but there was nonfunction on the right by intravenous pyelography. On catheterization of the right ureter an obstruction was met at 9 cm. although there was no difficulty to this point. Because of the acute septic condition a right nephrostomy was done followed by improvement. A pyeloureterogram (Fig. 2) made by injecting the nephrostomy tube as well as the ureter from below cystoscopically revealed hydronephrosis and a dilated ureter down to the pelvic brim where an abrupt stricture was evident. The lower ureter appeared normal. The degree of dilatation had undoubtedly decreased following the nephrostomy but these abnormalities were clearly evident on the films, which unfortunately were too light for good reproduction, therefore the outline has been traced in the illustration. At exploration the ureter was found so adherent to enlarged hard nodes over the iliac artery that a section of ureter had to be removed to overcome the obstruction. The

ureteral defect was bridged with a vitallium tube. Pathologic examination revealed carcinomatous metastasis, probably of rectal origin, and direct invasion of the ureteral wall from the nodes. The vitallium tube was demonstrated to be patent one month later, but at autopsy eighteen months later further cancerous growth and precipitation of urinary salts inside the metal tube had again obstructed the ureter. Except for the history regarding the rectal operation two years previously, the actual cause of this ureteral obstruction was not suggested until exploration even though the common causes of ureteral obstruction seemed excluded.



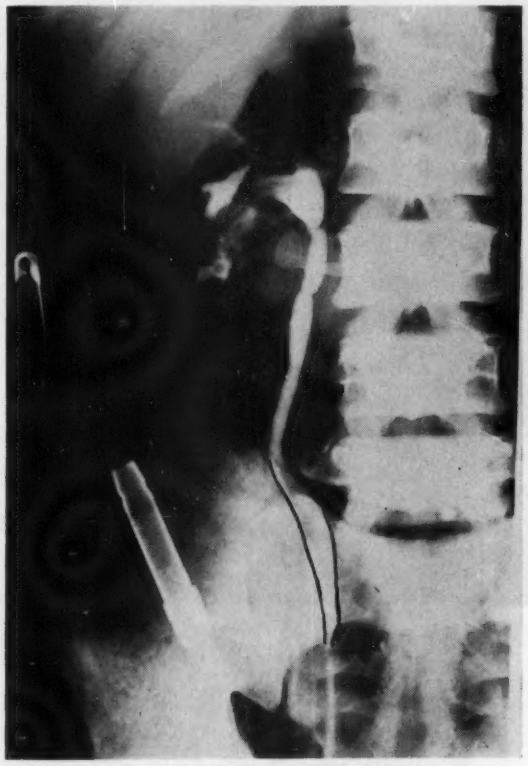
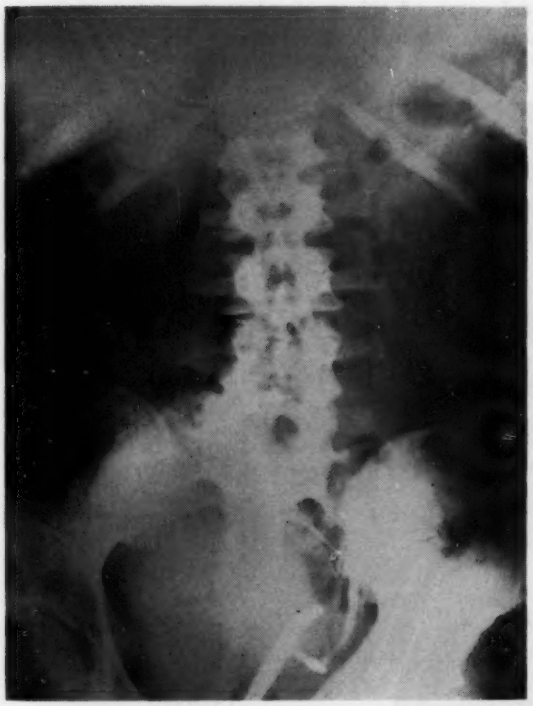


Fig. 1 (Case 1).—Woodruff pyeloureterogram demonstrating abrupt obstruction at the pelvic brim due to Hodgkin's disease.

Fig. 2 (Case 2).—Retouched pyeloureterogram showing abrupt obstruction at the pelvic brim due to iliac node metastases.

CASE 3 (N. Y. H. No. 458051).—F. M., a 57-year-old man, was admitted to the hospital in 1946 complaining of pain and a persistently draining urinary fistula in the left flank. A resection of the sigmoid for carcinoma had been done two years previously. The patient remained asymptomatic until one month before admission when evidences of an acute perinephritic abscess led to incision and drainage at another hospital. The perinephritic abscess seemed related to ureteral obstruction but the urologic studies performed elsewhere failed to clarify the etiology more specifically. A barium enema showed no bowel lesion. After the patient's transfer, studies on the right upper urinary tract found it to be normal, but a left hydronephrosis with poor function was shown by intravenous pyelography. Here again, catheters met an obstruction 10 cm. from the ureteral orifice though there was no difficulty up to this level. With the Woodruff technique (Fig. 3) complete obstruction was demonstrated at the pelvic brim, but the lower ureter appeared normal. A diagnosis of ureteral obstruction due to metastatic carcinoma in the iliac nodes was made and was con-

firmed by exploration and biopsy. Nephrectomy was done for symptomatic relief. The characteristic findings regarding the obstruction permitted the preoperative diagnosis, though the patient would otherwise have been supposedly free of cancer.



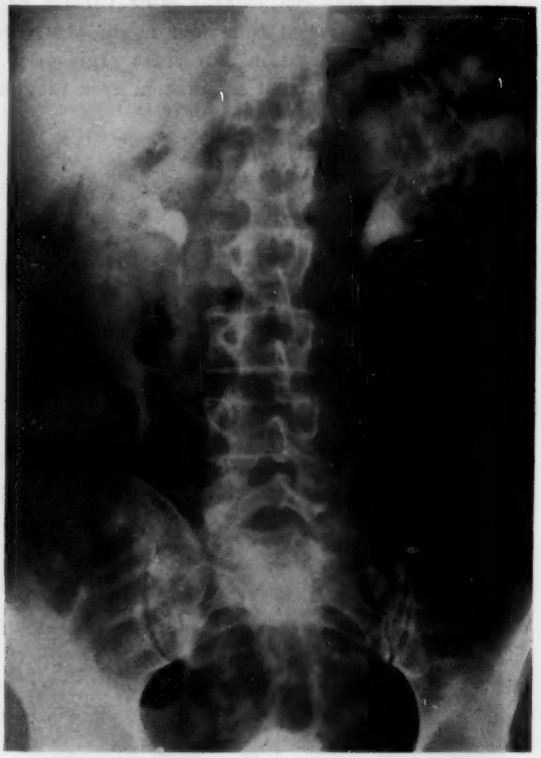


Fig. 3 (Case 3).—Ureterogram by Woodruff technique demonstrating a normal pelvic ureter obstructed at the pelvic brim by iliac lymph node metastases from carcinoma of the sigmoid.

Fig. 4 (Case 4).—Normal intravenous pyelogram eight months before onset of right flank pain.

CASE 4 (M.H. No. 81751).—W. H.,* a 66-year-old man, was admitted in 1947 with a chief complaint of pain in the right flank. An abdominoperineal removal of the rectum for carcinoma had been done eight months previously, but frequently examinations thereafter had found the patient in apparently excellent condition. General physical and laboratory examinations revealed no abnormality except operative scars and the colostomy. Studies of the left upper urinary tract were normal but intravenous pyelography showed no function on the right. After much manipulation a number 4 French catheter was passed by an obstruction 9 cm. above the ureteral orifice, though various catheters could be easily introduced up to this level. The best pyeloureterogram, by the Woodruff technique (Fig. 6), revealed hydronephrosis and a dilated ureter down to the pelvic brim where there was an abrupt constriction and some angulation. The lower ureter appeared normal. A preoperative diagnosis of metastasis to the right iliac nodes was made even though there were no palpable masses or any other evidence of residual cancer. This was confirmed by exploration and removal of a ureteral segment along with the single, rather small node which was found. Pathologic examination revealed that the metastasis had directly invaded the ureteral wall from the node. An end-to-end anastomosis was done over a splinting number 6 French catheter which was removed on the twenty-second postoperative day. The patient has remained asymptomatic in regard to the right upper urinary tract, the urine became normal within one month,

*Seen with Dr. Gray Twombly.

Fig. 5.

Fig. 6.

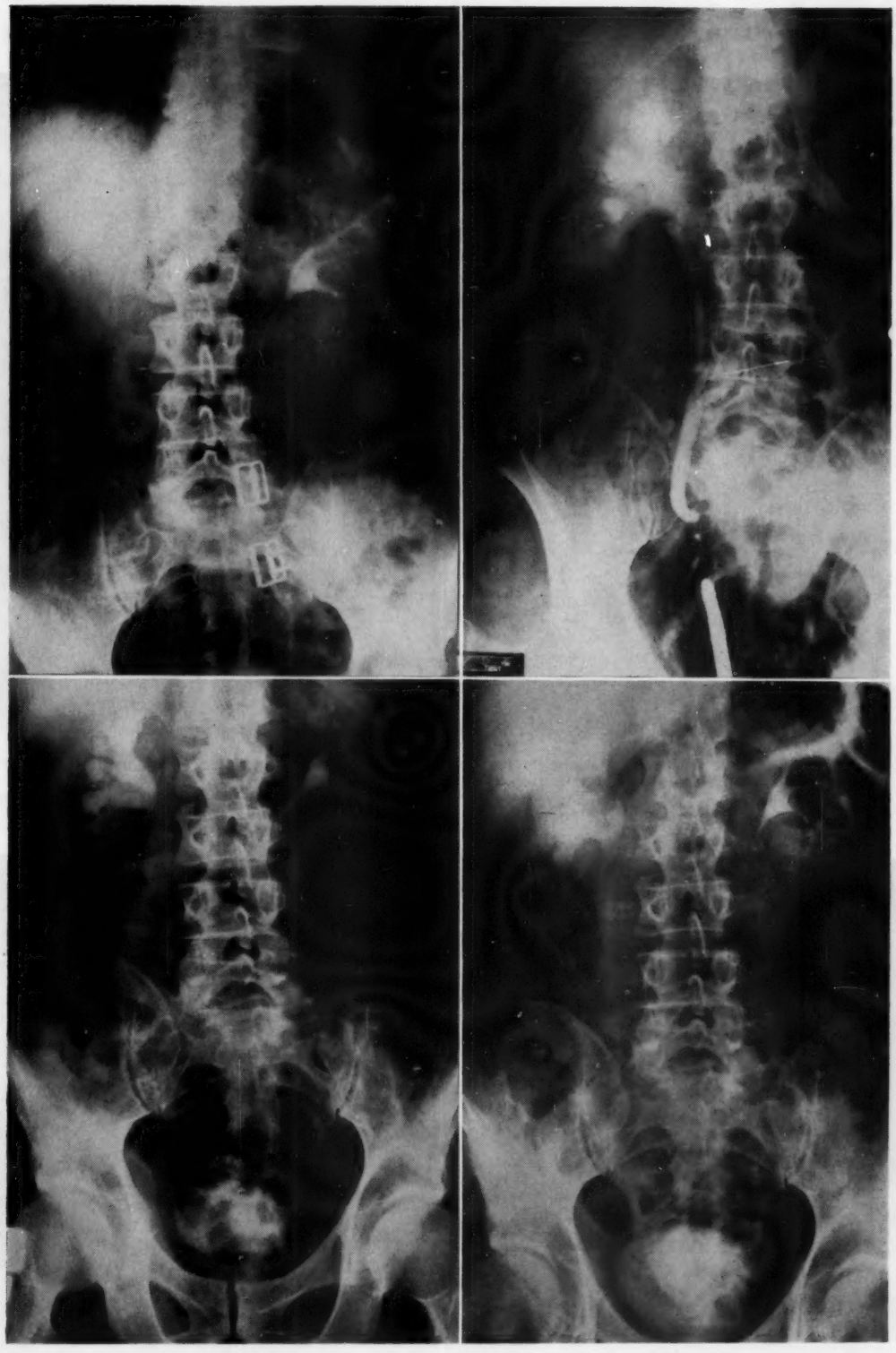


Fig. 7.

Fig. 8.

Fig. 5 (Case 4).—Intravenous pyelogram with nonfunction on the right, but an apparently normal kidney with good function on the left.

Fig. 6 (Case 4).—Woodruff pyeloureterogram revealing abrupt and limited obstruction at the pelvic brim due to iliac metastases from rectal carcinoma.

Fig. 7 (Case 4).—Intravenous pyelogram one month after ureteral resection; return of function is evident.

Fig. 8 (Case 4).—Intravenous pyelogram nearly two months after right ureteral resection; note normal left pyelogram.

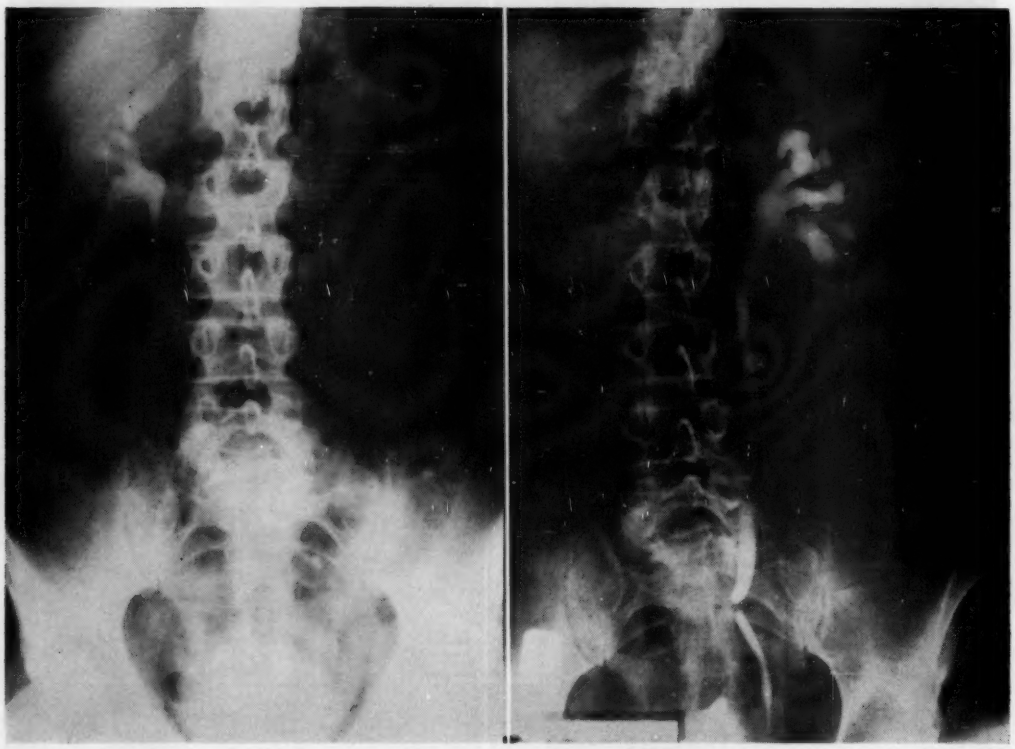


Fig. 9 (Case 4).—Intravenous pyelogram nearly four months after right ureteral resection, but demonstrating loss of function on the left.

Fig. 10 (Case 4).—Pyeloureterogram of the left side demonstrating limited area of obstruction at the pelvic brim due to metastases from rectal carcinoma.

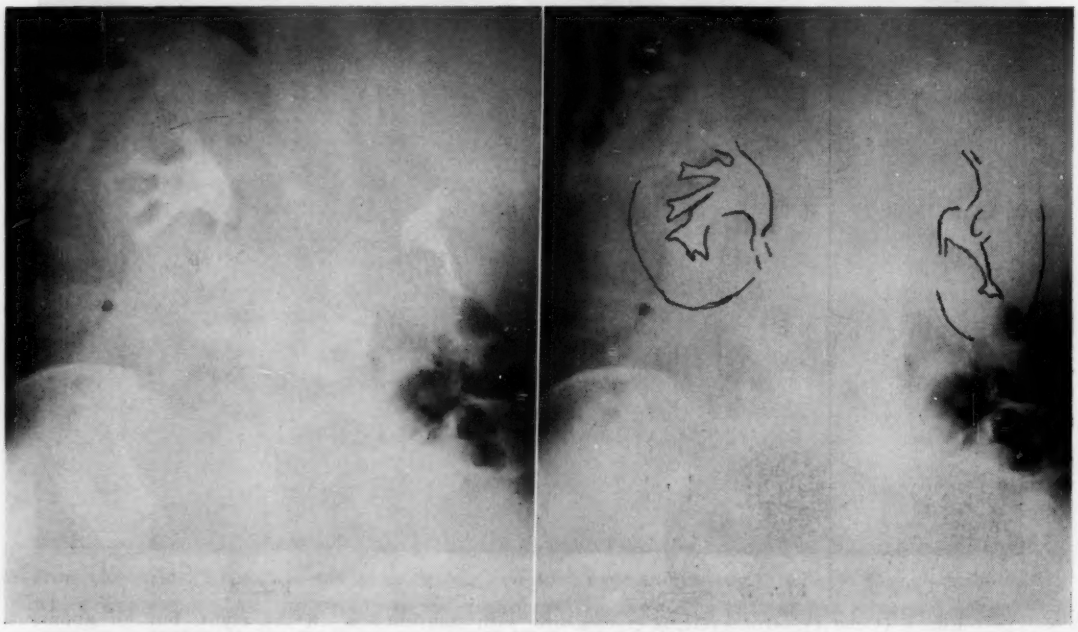


Fig. 11 (Case 4).—Intravenous pyelograms approximately five months after right ureteral resection and three weeks after left ureteral resection demonstrating bilateral function with only mild hydronephrosis.

Fig. 12 (Case 4).—Tracings of the pyelograms of Fig. 11.

and the hydronephrosis has almost disappeared (Figs. 9, 11, and 12). In fact, as will be evident later in this communication, this kidney has been able to maintain the patient satisfactorily through another operation in the absence of appreciable function of its mate. Here again, the patient was considered healthy except for recent ureteral obstruction. This obstruction was evidently not due to stone, primary ureteral neoplasm, traumatic stricture, or pregnancy, but was nearly identical to those in the preceding cases.

As if this were not enough, this patient returned three months later complaining of an exactly similar pain in the left flank of one day's duration. General physical and laboratory examinations were again of no aid in establishing the diagnosis, but the old pattern, consisting of flank pain, hydronephrosis and dilatation down to the pelvic brim, obstruction to ureteral catheters 9 cm. above the ureteral orifice, and an apparently normal lower ureter, was familiar. Almost needless to say, the diagnosis was made and confirmed. Resection of the ureter with end-to-end anastomosis was again carried out in the same manner. The final technical result could not be determined as death occurred two months later. The patient did have an episode of fever and pain in the left flank during the terminal stage of carcinomatosis. The first indication of spread of malignant disease was ureteral obstruction of the type described in the other cases.

Fortunately an intravenous pyelogram was made before the abdominoperineal operation and frequent pyelograms thereafter, so that the development, as well as the radiologic characteristics, of this case can be serially illustrated (Figs. 4 through 12).

DISCUSSION

Analysis of these cases revealed the following features common to all:

1. Flank pain without significant urinary symptoms was the presenting complaint.
2. A hydronephrotic or nonfunctioning kidney (by intravenous pyelography) was present upon the involved side.
3. The ureteral constriction was consistently present at the pelvic brim and was invariably located 9 to 10 cm. above the ureteral orifice.
4. The ureter below the point of constriction was normal.
5. The length of the constriction was never more than 3 mm., usually only 1 mm.
6. The cause of the constriction was proved in each instance to be neoplastic involvement of the iliac lymph nodes.

If these features, however, are to be accepted as diagnostic of iliac lymphadenopathy, the recognized causes of ureteral obstruction at the pelvic brim must be excluded. In general, a careful urologic survey can be relied upon to demonstrate a ureteral calculus or a primary ureteral neoplasm. A traumatic stricture should give signs and symptoms early following the injury. Pregnancy can be readily excluded. An iliac aneurysm should be recognized by its diagnostic calcification. Congenital valves, folds, and aberrant vessels causing marked obstruction are usually manifest at an early age and, rarely, at this particular level. Preoperatively the exclusion of idiopathic stricture was difficult. However, idiopathic strictures are rarely so sharply demarcated and are unlikely to present so consistently at this specific level. Furthermore, a common characteristic of this type of constriction is chronicity whereas the illness in each of the patients in this series was acute. In a reasonably complete review of the patients with tuberculous ureteritis seen in these clinics only one was

discovered in whom the pyeloureterograms closely resemble those obtained in the patients in this series. In this case, however, the obstructing lesion at the pelvic brim involved several centimeters of ureter (Fig. 14).

As a result of the experience gained from these four cases, the diagnosis of ureteral obstruction due to carcinomatous metastasis in the iliac nodes was made without operation in the following case.

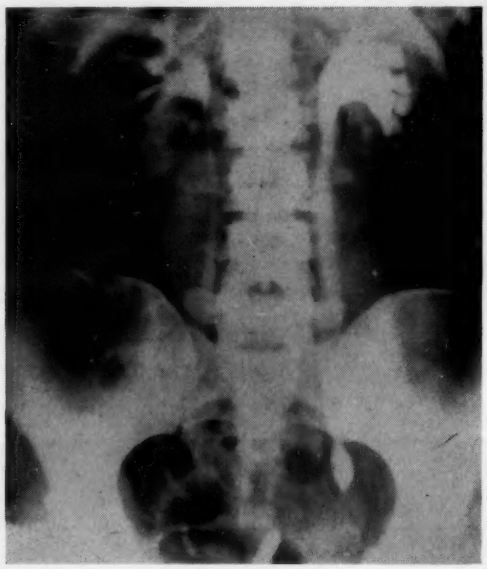


Fig. 13 (Case 5).—Pyeloureterogram showing obstruction at the pelvic brim, presumed to be due to metastases from carcinoma of cervix.

Fig. 14.—Pyeloureterogram of proved tuberculous ureteritis (left). This is similar to, but not typical of, ureteral obstruction due to iliac lymph node disease. In the first place the area of obstruction is 2 cm. below the pelvic brim and in the second place it is not sharply delimited but extends over a segment of several centimeters.

CASE REPORT

CASE 5 (N.Y.H. No. 433351).—G. L.,* a 41-year-old woman, complained of pain in the right flank for six weeks. Cancer of the cervix had been treated by radiation with regression but not disappearance. The residual neoplasm seemed limited to the cervix and uterus on pelvic examination. General physical and laboratory examinations revealed no other abnormality. Studies of the left upper urinary tract were normal but a right hydronephrosis was shown by intravenous pyelograph. Ureteral catheterization met obstruction 9 cm. above the orifice though catheters were easily passed to this level. With the Woodruff technique a pyeloureterogram (Fig. 13) demonstrated hydronephrosis with a dilated ureter down to the pelvic brim where an abrupt constriction and angulation occurred. The lower ureter appeared normal. This obstruction was above the broad ligament, the pelvic ureter was normal, and there was no demonstrable extension of the cervical cancer beyond the uterus, so the obstruc-

*Seen with Dr. Norman Treves.

tion was considered due to metastases in the iliac nodes, especially as the diagnostic pattern was the same as in the previous cases. Subsequently, the right kidney became nonfunctioning by intravenous pyelography, but carcinomatosis soon appeared and the patient died. The first indication of carcinomatosis, however, was the ureteral obstruction from the iliac metastases. The subsequent course seemed to bear out the diagnosis of iliac metastases even though positive proof was lacking.

SUMMARY

Four cases have been presented in which an acute ureteral obstruction was proved to have been due to iliac lymphadenopathy. In a fifth case clinical evidence warranted the same diagnosis.

A diagnostic pattern has been described by which it is believed that this type of ureteral obstruction can be recognized even though the offending iliac nodes are not large enough to be palpated either on abdominal, pelvic, or rectal examination.

ARTERIAL AND VENOUS HYPERTENSIVE STATES BENEFITED BY SURGICAL INTERVENTION

JERE W. LORD, JR., M.D., NEW YORK, N. Y.

DURING the past ten years three surgical techniques have been developed which influence favorably a group of circulatory states exhibiting hypertension as their outstanding feature. Let us consider them in the order of the condition influenced most successfully by operative intervention.

In 1945 Crafoord and Nylin[1] and Gross and Hufnagel[2] reported independently the resection of the stenosed segment of the aorta with end-to-end anastomosis for relief of hypertension in the upper half of the body of patients suffering from coarctation of the aorta. Recently Gross[3] reported some twenty-three patients operated upon, with successful anastomosis accomplished in seventeen. Only two of the seventeen patients died. We* have operated upon three patients with coarctation of the aorta. Their case reports follow.

CASE REPORTS

CASE 1.—In a colored boy, 12 years of age, it was impossible to accomplish a resection of the stenotic area of the aorta because it arose immediately beyond the left common carotid artery. There was no left subclavian artery. The end of the left third intercostal artery was anastomosed to the side of the common carotid artery but the anastomotic opening was small and somewhat angulated. The postoperative angiocardiogram showed no evidence of function (Fig. 1). The patient showed no change one way or the other in the postoperaive follow-up of six months.

CASE 2. (K. 10255).—M. C., a 27-year-old white woman, was admitted to the New York Post-Graduate Hospital on April 21, 1947. She was referred by the physicians who made the diagnosis and advised surgical intervention. For two and one-half years the patient had known high blood pressure was present, and for several months prior to operation it had fluctuated between 270/110 and 330/160. The patient was completely asymptomatic. Preoperative angiocardiogram at the New York Hospital showed a proximal stump of aorta 1.0 cm. beyond the left subclavian artery (Fig. 2). Also the thickness of the left ventricle was 1.5 cm., 0.5 cm. beyond the normal limit. On April 26 the stenosed segment of aorta was resected and end-to-end anastomosis carried out with 00000 Deknatel silk (Fig. 3, *A*, *B*, and *C*). A lumen 8 mm. in diameter was fashioned. The postoperative convalescence was uneventful and the patient was discharged on the twenty-first day.

Fig. 4 is a chart of the patient's preoperative and postoperative blood pressure levels. It is of interest that a relatively normal blood pressure in the arms was attained only four months after operation. Preoperatively no pulsation could be felt in the abdominal aorta or in the feet although a blood pressure of 130/105 was obtainable with the stethoscope placed in the popliteal space. The postoperative blood pressure in the legs averaged 160/120 and good pulsations were present in the abdominal aorta and in the feet. Preoperatively oscillometric examination was 2.0 in the calf at 80 mm. of mercury, whereas on the eleventh postoperative day it was 2.5 and at six months it was 4.5 at 110. Teleroentgenograms showed a decrease in the transverse diameter of the heart of 1.5 cm. (Fig. 5, *A* and *B*). The patient became asymptomatic although it required three months for her to regain full strength.

*The three operations for coarctation of the aorta were carried out in conjunction with Dr. Louis R. Davidson.

CASE 3 (K11787).—F. P., a 24-year-old white married housewife, was admitted to New York Post-Graduate Hospital on June 16, 1947. She had known high blood pressure was present for four years. In February, 1947, the patient suffered a stroke from which she recovered in two weeks, leaving no residual weakness. On admission the blood pressure in the arms was 235/135 and 0/0 in the legs. Oscillometric examination in the left calf was 0.2/100. She was operated upon on June 21, 1947; the stenosed segment of aorta was resected and an end-to-end anastomosis carried out (Fig. 6, *A* and *B*). A lumen approximately 15 mm. in diameter was fashioned and the procedure was considerably easier than in Case 2 because there were 2.5 cm. of normal aorta proximal to the narrowed zone but distal to the left subclavian artery. There was a persistent tachycardia of 140 to 150 for the first five days postoperatively, but from then on the patient made an uneventful recovery.

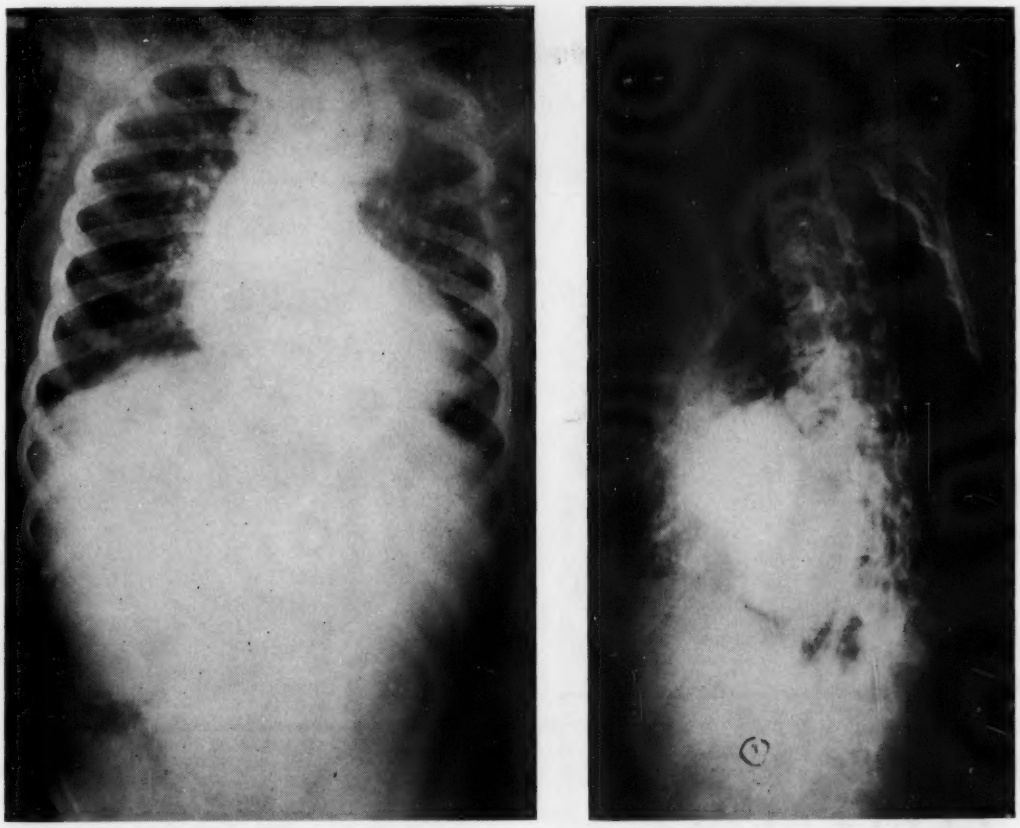


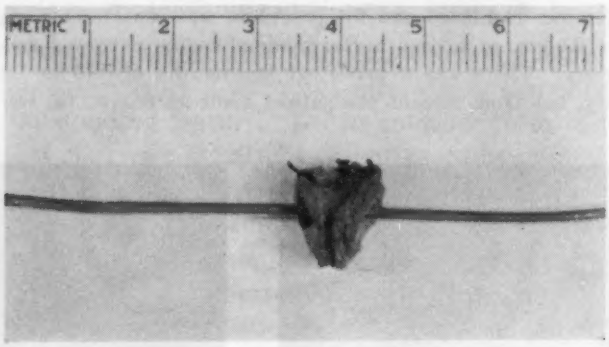
Fig. 1.—Postoperative angiocardiogram showing dilation of the left common carotid artery, absence of the left subclavian artery, and no evidence of function of the anastomosis.

Fig. 2.—Preoperative angiocardiogram showing the 1 cm. stump of the aorta distal to the left subclavian artery.

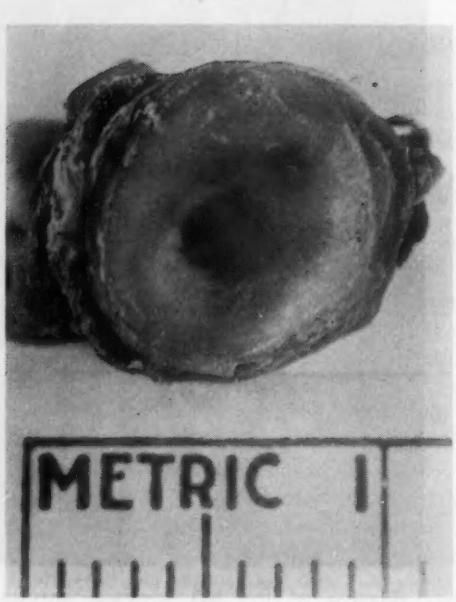
Fig. 7 is a chart of the pre- and postoperative blood pressures. The oscillometric examinations in the calf were 0.2/100 preoperatively, 3.5/110 at two months, and 6.0/100 at four months postoperatively. Pulsations in the legs absent preoperatively were normal after operation. This patient regained full strength one month after operation and has remained asymptomatic.

By way of comment the following facts seem established: (1) Reifenstein and his associates[4] analyzed 104 autopsied cases of coarctation of the aorta and found that, as a group, life was shortened (average age at death, 35 years)

and complications related to the hypertension occurred in 76 per cent of the patients; (2) the operation described by Crafoord and Nylin[1] and by Gross has proved to be a long one, averaging in our hands six and one-half hours. The procedure has been well tolerated; (3) if the anastomosis is satisfactory the circulatory dynamics return to normal.



A.



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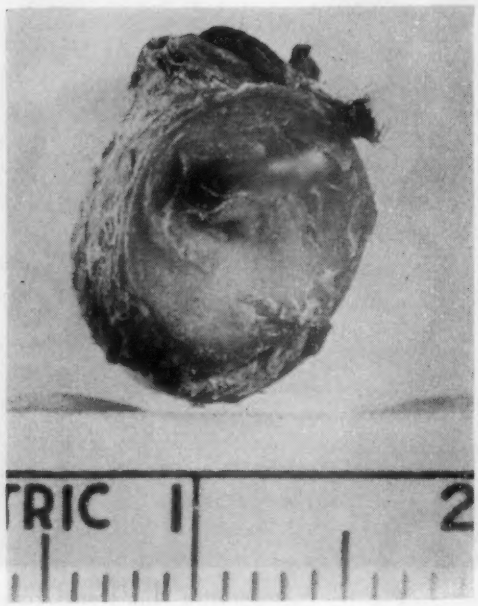


C.

Fig. 3.—*A*, Resected stenotic area of aorta capable of barely admitting a probe: *B*, view from one end; *C*, view from the other end.

The second hypertensive state favorably influenced by surgical intervention is essential and malignant arterial hypertension. Smithwick[5] is the surgeon most responsible for widespread interest in thoracolumbar sympathectomy for relief of this condition and his operation or some modification of it[6, 7, 8] is being utilized by many surgeons throughout the country. The results of my small personal series are quite similar to the larger series reported with Hinton.[9] Twenty patients have been operated upon and there have been three deaths. Two of

these occurred postoperatively some four hours and three days from a coronary occlusion and cerebral thrombosis, respectively. Neither of these patients should have been operated upon as each one's hypertensive state was too far advanced to withstand the effects of operation. The first patient had experienced a coronary occlusion two years prior to operation and for one year had exhibited progressive cerebral damage evidenced by difficulty in thinking and thick, slowed speech. Autopsy revealed a fresh coronary occlusion and multiple areas of softening and scarring throughout the brain. The second patient suffered from malignant hypertension and was in congestive heart failure and mild uremia on admission. The eye grounds were 4 plus and the total count was 12 plus.

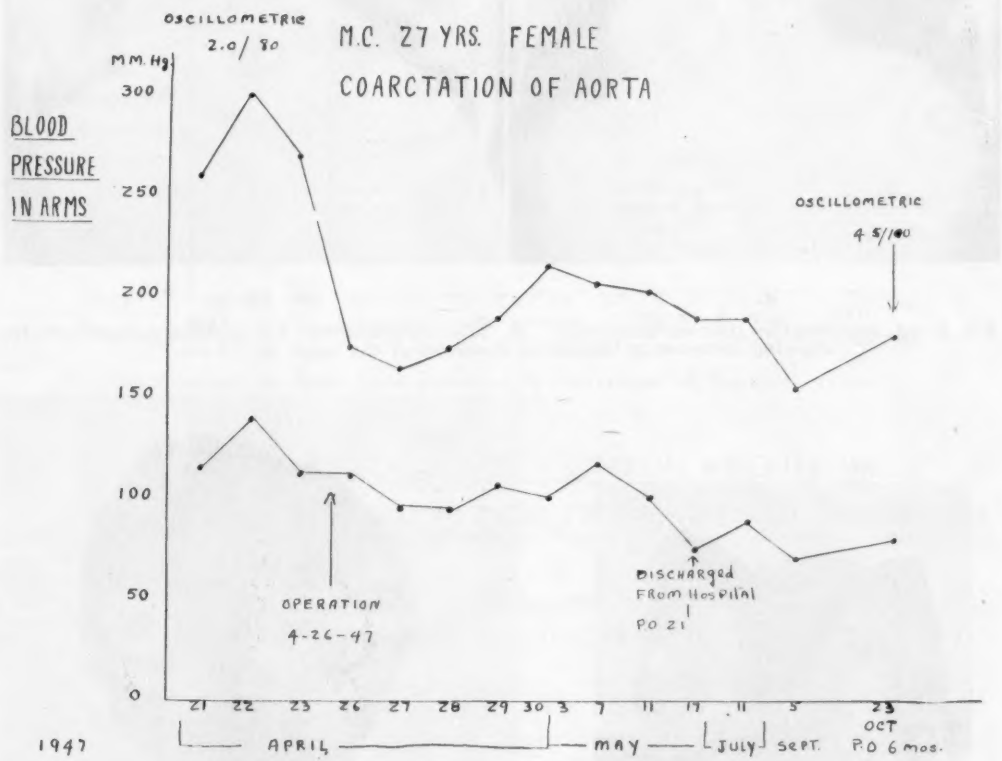
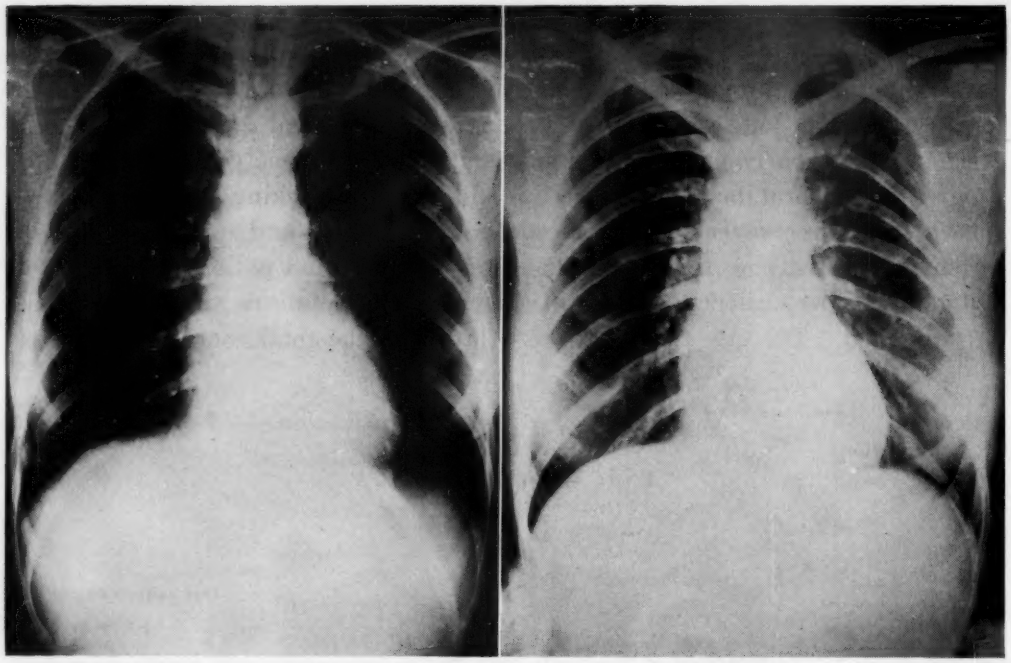


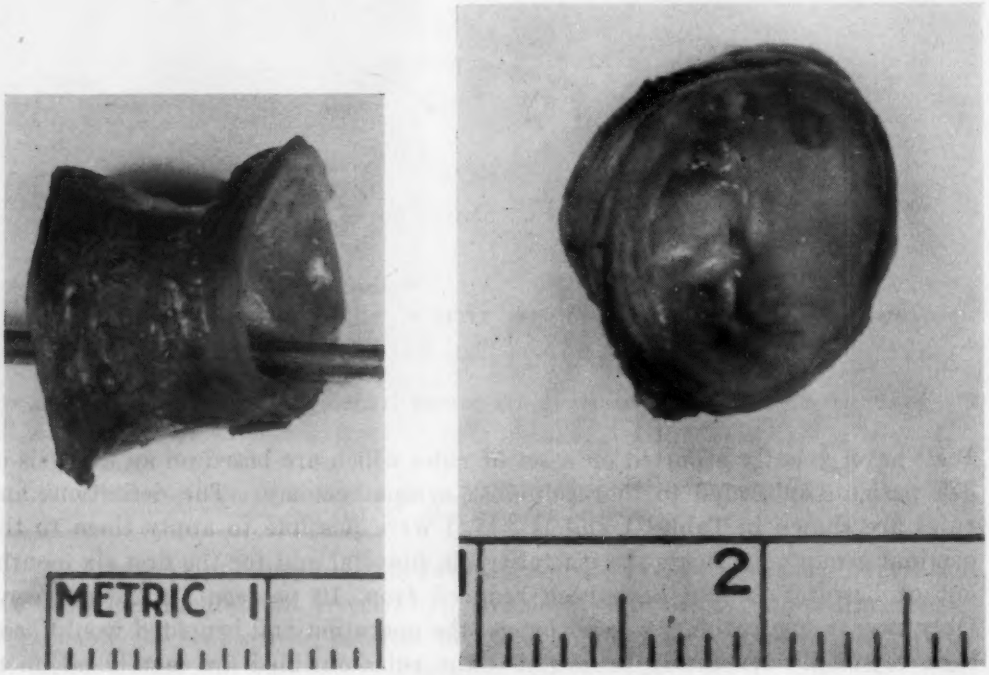
Fig. 4.—Chart showing blood pressures of one patient (Case 2) with coarctation of the aorta.

We[10] have recently reported on a set of rules which are based on an analysis of 375 patients subjected to thoracolumbar sympathectomy. The definitions and rules are shown in Tables I and II. If it were possible to apply them to the original group of patients the mortality (in hospital and for the first six months out of hospital) would have been reduced from 10 per cent to 2.5 per cent. Only twenty-five patients who withstood the operation and benefited would have been rejected. We firmly believe that the rules outlined are merely adjuncts to sound clinical judgment and are not intended to be a substitute for good judgment. Both of these hospital deaths would have been eliminated if the rules had been developed prior to their preoperative study and analysis. The third



A. *B.*

Fig. 5.—*A*, Preoperative teleroentgenogram. *B*, Teleroentgenogram, five months postoperatively, showing decrease in transverse diameter of the heart by 1.5 cm.



A. *B.*

Fig. 6.—*A*, Lateral view of resected stenotic area from Case 3. *B*, View from one end.

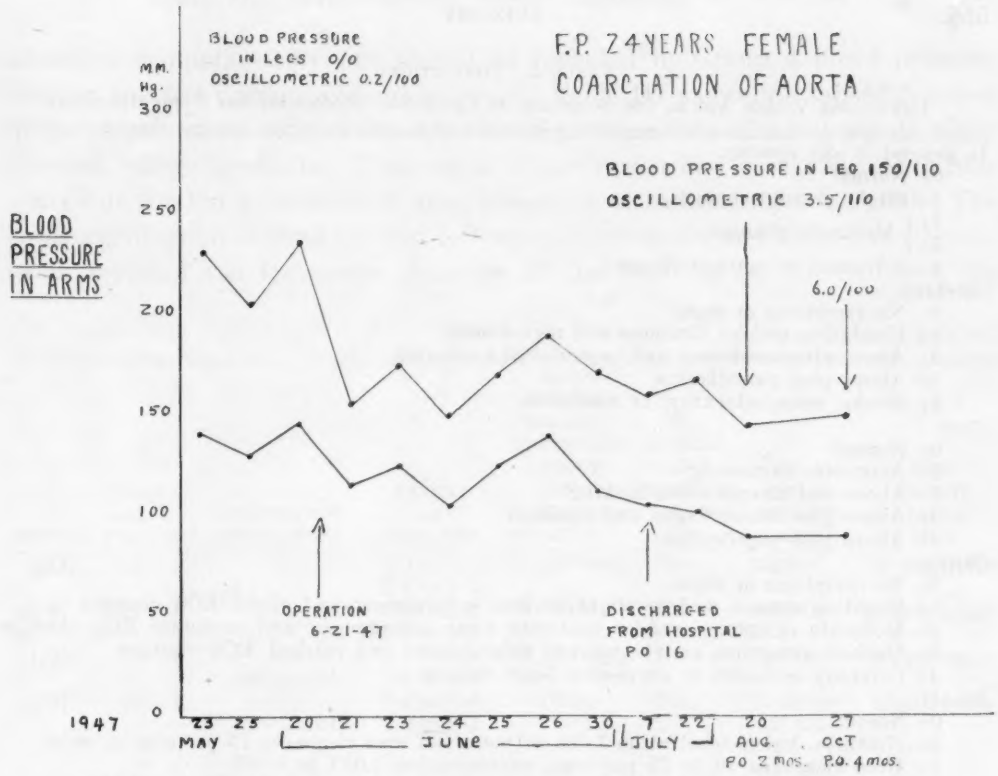


Fig. 7.—Chart showing blood pressures in coarctation of the aorta (Case 3).

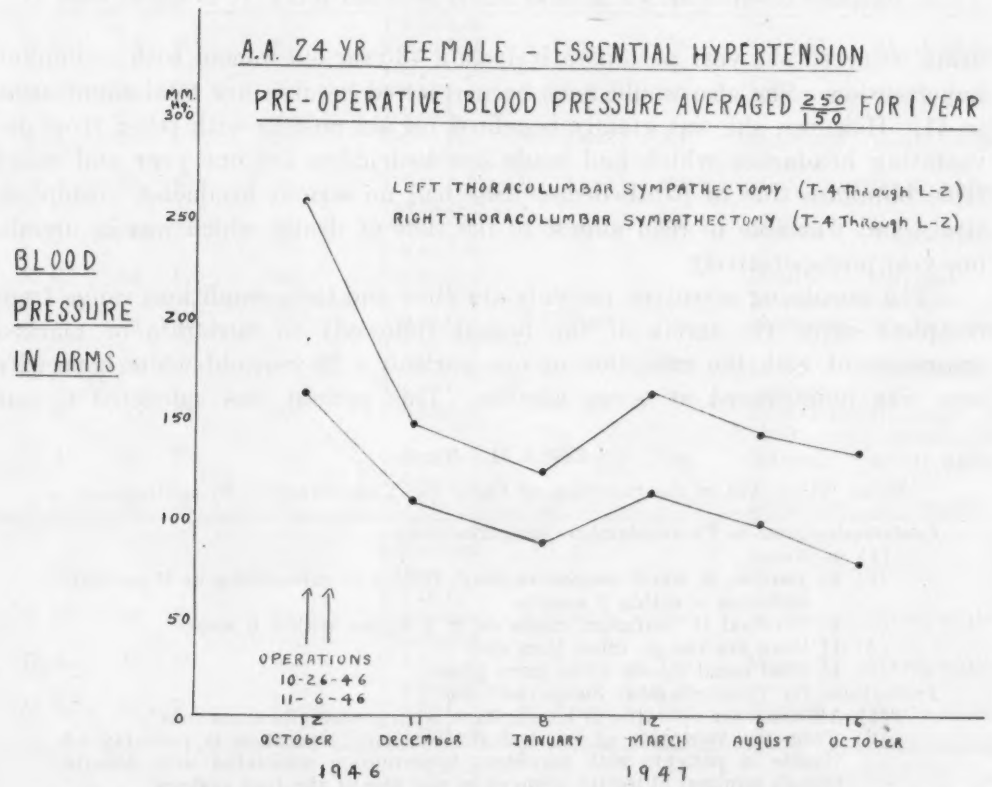


Fig. 8.—Chart showing blood pressures of patient with severe essential hypertension.

TABLE I. DEFINITIONS

Definitions Which Aid in the Selection of Cases for Thoracolumbar Sympathectomy

In general in any system:
- 0+ Normal
- 1+ Slight or mild changes
- 2+ } Moderate changes
- 3+ }
- 4+ Advanced or marked changes

Cerebral:
- 0+ No symptoms or signs
- 1+ Headaches and/or dizziness and nervousness
- 2+ Above plus nosebleeds and/or occipital headaches
- 3+ Above plus paresthesias
- 4+ Stroke, encephalopathy, or confusion

Eyes:
- 0+ Normal
- 1+ Arteriolar narrowing
- 2+ Above and arteriovenous nicking
- 3+ Above plus hemorrhages and exudates
- 4+ Above plus papilledema

Cardiac:
- 0+ No symptoms or signs
- 1+ Slight symptoms and/or slight cardiac enlargement and slight ECG changes
- 2+ Moderate symptoms and/or moderate x-ray enlargement and moderate ECG changes
- 3+ Marked symptoms and/or marked enlargement and marked ECG changes
- 4+ Coronary occlusion or congestive heart failure

Renal:
- 0+ Normal
- 1+ Nocturia, but concentration 1.024 or more and urea clearance 75 per cent or more
- 2+ Urea clearance 40 to 75 per cent, concentration 1.015 to 1.023
- 3+ Urea clearance less than 40 per cent, concentrate less than 1.015, normal blood chemistry
- 4+ Persistent elevation of N.P.N. to 45 mg. or more and B.U.N. to 25 mg. or more.

death occurred one year postoperatively in a 43-year-old woman with malignant hypertension. She also would have been rejected because her total count came to 11. However, she was greatly benefited for six months with relief from devastating headaches which had made her bedridden for one year and relief from blindness due to papilledema. She had no serious headaches postoperatively and was able to read almost to the time of death, which was in uremia one year postoperatively.

The remaining seventeen patients are alive and their conditions range from complete cures (in terms of the period followed) to moderate or marked improvement with the exception of one patient, a 26-year-old white housewife who was unimproved at seven months. This patient was subjected to our

TABLE II. RULES

Rules Which Aid in the Selection of Cases for Thoracolumbar Sympathectomy

Contraindications to Thoracolumbar Sympathectomy:
- (1) 4+ Renal
- (2) 4+ Cardiac in which congestive heart failure is unremitting or if coronary occlusion is within 3 months
- (3) 4+ Cerebral if confusion exists or if a stroke within 6 weeks
- (4) If there are two 4+ other than eyes
- (5) If total count equals 11 or more pluses

Indications for Thoracolumbar Sympathectomy:
- (1) All cases are operable in which there is no contraindication rule
- (2) From the viewpoint of minimal involvement: Operation is probably advisable in patients with persistent hypertension associated with definite though minimal objective changes in any one of the four systems

extensive sympathectomy but should be included in Group 4 blood pressure results; she felt unimproved subjectively. Table III shows the salient features of the twenty cases. Fig. 8 shows the blood pressure data of a 24-year-old white married college graduate. Presence of hypertension had been known for four years but for the year prior to sympathectomy it had averaged 250/150. The electrocardiogram showed marked left ventricular strain and the teleroentgenogram revealed the transverse diameter of the heart to be 1½ cm. over the

TABLE III

INITIALS	AGE (YR.)	SEX	PREPARATIVE EVALUATION	EXTENT OF OPERATION	BLOOD PRESSURE RESULT—SMITHWICK GROUP (MOST RECENT P.O. EXAM.)	DIASTOLIC BLOOD PRESSURE BELOW 100	OVER-ALL RESULT; IMPROVEMENT	SUBJECTIVE EVALUATION
M. L.	53	F	6+	T-9 to L-2 T-9 to L-2	1 (24 mo.)	Yes	Marked	Worth while
S. S.	45	F	5+	T-9 to L-2 T-9 to L-2	1 (15 mo.)	No	Moderate	Worth while
G. N.	35	F	12+ (malignant)	T-9 to L-2 T-9 to L-2	2 (24 mo.)	No	Marked	Worth while
R. H.	48	F	11+ (malignant)	T-9 to L-2 T-9 to L-2	4 (6 mo.)	No	Moderate (6 mo.) Dead 12 mo.)	Worth while Uremia
V. P.	51	F	8+	T-9 to L-2 T-9 to L-2	3 (24 mo.)	No	Moderate	Worth while
M. R.	45	F	5+	T-9 to L-2 T-9 to L-2	3 (24 mo.)	Yes	Moderate	Worth while
R. V.	33	F	8+	T-9 to L-2 T-9 to L-2	1 (24 mo.)	No	Marked	Worth while
M. K.	46	F	8+	T-6 to L-2 T-7 to L-2	3 (15 mo.)	No	Moderate	Worth while
R. J.	50	F	7+	T-5 to L-2 T-5 to L-2	4 (18 mo.)	No	Moderate	Worth while
M. F.	55	F	9+	T-7 to L-1 T-8 to L-2	2 (12 mo.)	Yes	Moderate	Worth while
S. G.	39	M	6+	T-6 to L-2 T-6 to L-2	1 (9 mo.)	Yes	Marked	Worth while
L. C.	43	F	12+ (malignant)	T-9 to L-2 T-9 to L-2			Dead P.O. 3 days	Cerebral accident
J. O.	34	M	8+	T-5 to L-2 T-6 to L-2	3 (12 mo.)	No	Moderate	Worth while
A. M.	26	F	7+	T-5 to L-2 T-4 to L-2	4 (7 mo.)	No	Unimproved	No benefit
G. S.	45	M	12+	T-6 to L-2			Died 4 hr. P.O.	Coronary occlusion
A. A.	24	F	8+	T-4 to L-2 T-4 to L-2	1 (12 mo.)	Yes	Marked	Worth while
J. T.	60	M	8+	T-10 to L-2 (1943, Sydenham Hosp.) T-3 to L-3	1 (9 mo.)	Yes	Moderate	No benefit
E. M.	39	F	4+	T-4 to L-3 T-4 to L-3	4 (6 mo.)	No	Moderate	Worth while
H. S.	48	M	9+	T-9 to L-2 T-8 to L-2	1 (2 mo.)	Yes	Markedly	Worth while
M. S.	42	F	5+	T-3 to L-3 T-3 to L-3	1 (9 mo.)	Yes	Marked	Worth while

upper limits of normal. The patient had a two-stage extensive thoracolumbar sympathectomy (from the fourth thoracic through the second lumbar ganglia inclusive) and was fully recovered in two months. She felt entirely well and had a normal blood pressure. The postoperative electrocardiogram and chest roentgenogram showed marked improvement.

It would seem that thoracolumbar sympathectomy is an operation which brings relief to many patients with hypertension. However, in the too far advanced cases it usually fails. The decision on whether or not it will ever effect so-called "permanent" cures must await the passage of another twenty years. We believe that the extensive sympathectomy (from the third or fourth thoracic through the second or third lumbar vertebrae) should be reserved for milder cases in the younger age group and the classical Smithwick sympathectomy (eighth or ninth thoracic through second or third lumbar ganglia) should be used in patients with more advanced stages of hypertension and in older patients.[11]

The third hypertensive state favorably influenced by surgical intervention is portal hypertension. This condition may be due to an intrahepatic block (cirrhosis of the liver) or to an extrahepatic block (Banti's syndrome) due to thrombosis of the portal vein or the splenic vein or to cavernomatous transformation of the portal vein. The two chief symptoms by which portal hypertension may be manifested are hemorrhage from esophageal varices and ascites. The latter is usually due to hypoalbuminemia but ascites which persists after prolonged liver therapy may be due to portal hypertension. The first successful operation for this condition was developed by Blakemore and his associates[12, 13] in 1943. Recently Blakemore[14] reported forty patients operated upon for portal hypertension with only five deaths. Linton[15] reported a series of fifteen cases with five deaths, all in patients suffering from cirrhosis of the liver. Linton had much greater success with patients of the Banti type. Follow-up in both series has shown a number of patients whose hemorrhages have ceased or have been greatly diminished in frequency and in volume. Also ascites has usually been eradicated postoperatively. Liver function on the other hand has not been significantly altered.

I have carried out anastomosis between the portal system and caval system in six patients. In three an anastomosis was made between the end of the portal vein and the side of the inferior vena cava by means of a vitallium tube. One of these patients died in the hospital on the eleventh postoperative day of an adynamic duodenal ileus due to a small infected retroduodenal hematoma. It is believed that if the anastomosis had been performed by end-to-side suture as advocated by Blalock,[16] John,[17] and Welch[18] that this patient would have survived. A severe hemorrhage occurred from a small branch of the inferior vena cava when the lower Blakemore-Crump clamp was being applied. This hemorrhage was difficult to control, led to temporary shock, and prolonged the operation one hour. In the suture method only the anterior part of the cava is obstructed and not nearly as wide a posterior dissection is necessary. At autopsy the anastomosis was patent. The patient had a typical portal cirrhosis. The second patient who died in the hospital was also suffering from

portal cirrhosis and died from cholemia on the fourteenth postoperative day after getting along fairly well for ten days. Again failure may have been due to the extreme measures necessary to obtain a sufficient length of portal vein for the vitallium tube anastomosis.

The third patient was a 48-year-old white man who had portal cirrhosis and also a marked impairment of renal function bilaterally. The two-hour phenolsulfonphthalein test showed only 15 per cent excretion and the urea clearance was 45 per cent of normal. Intravenous pyelogram showed poor function bilaterally. The patient withstood the portacaval anastomosis by means of the vitallium tube very well and did not develop ascites after two paracenteses performed during the third and fourth postoperative weeks. He developed anasarca five months postoperatively and died eight months after operation in uremia. Autopsy showed the anastomosis between the end of the portal vein and the side of the inferior vena cava to be entirely patent.

Of the three patients* who had splenorenal anastomosis one improved greatly, one died five months postoperatively, and the third was in fair condition six weeks postoperatively. It is of great interest that in this small series of three cases, there were double renal veins in two of them. In the second case the two renal veins were so small (appoximately 5 mm. each in diameter) that an end-to-end anastomosis between the large splenic vein (15 mm.) was difficult and proved at autopsy to have thrombosed. This man had an obvious cirrhosis of the liver at operation but at autopsy five months postoperatively in addition to the cirrhosis the portal vein was found to be thrombosed. It was concluded that he represented a late stage of the Banti syndrome with a significant degree of cirrhosis of the liver.

In the two living patients with splenorenal conditions the operative diagnoses were portal cirrhosis although in the most recent one the preoperative diagnosis was Banti's syndrome. At operation the very high pressure of 540 mm. of water was measured in a branch of the left gastroepiploic vein and is therefore suggestive of a combined intra- and extrahepatic portal vein block.

From the experience gained in this small series of patients suffering from portal hypertension the following suggestions are made:

1. A splenorenal anastomosis is preferable to a portacaval anastomosis because it (a) is easier, (b) safer, (c) does not necessarily shunt all of the portal vein blood from the liver, and (d) eliminates the splenic artery which carries approximately 25 to 30 per cent of the blood which ordinarily must pass through the liver.

2. The anastomosis is best done by an end-to-side suture between the end of the splenic vein and the side of the left renal vein because: (a) Johns has shown this type of anastomosis remains open experimentally more frequently than the end-to-end suture and the end-to-end vitallium tube technique; (b) the left kidney is not sacrificed; (c) less length of vein is required when the suture method is employed than in the vitallium tube technique.

*I performed the complete operation in all but one of the six patients. In this one, the patient who had a splenorenal anastomosis and who died five months postoperatively, Dr. William F. Nickel carried out all of the procedure except for the anastomosis.

3. Results will improve and mortality will be lowered as the selection of cases is better delineated and as greater operative experience is gained.

SUMMARY

Three types of arterial and venous hypertensive states are now benefited to some degree by surgical intervention.

1. Coarctation of the aorta may be completely relieved by resection of the stenotic area and end-to-end anastomosis of the aorta.

2. Essential and malignant arterial hypertensive cases will to a significant degree be favorably altered by thoracolumbar sympathectomy.

3. Portal hypertension may be partially relieved with improvement in a fair percentage of cases by an anastomosis between the portal system and caval system of veins.

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THE RISK OF SURGERY IN HEART DISEASE

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THE problem of heart disease in surgical patients is one of ever-increasing interest and importance. Our population is becoming older as each decade passes and consequently the incidence of arteriosclerotic heart disease is on the increase. At the same time these older people become more susceptible to the various diseases requiring surgical treatment, such as cancer, prostatism, and the complications of peptic ulcer. In a similar fashion the improved treatment of rheumatic fever and syphilis has brought about a higher survival rate in these diseases, which again exposes increasing numbers of people to the necessity of surgical treatment in the presence of their already damaged hearts.

It seems pertinent then, to examine our experience with heart disease in the surgical patient with the idea of determining the operative risk in these cases and the various factors contributing to it.

This report is based on the detailed analysis of a group of 478 inpatients with heart disease who were subjected to 701 operations, comprising our total experience in this field during the ten-year period 1933 to 1943. Patients with minor procedures performed in the outpatient department were excluded from this study. No selection was exercised except that certain cases in which the diagnosis of heart disease was equivocal were excluded. Three etiologic types of heart disease are considered, namely rheumatic, arterio- sclerotic, and syphilitic, and each of these is further considered under its respective anatomic, physiologic, and functional aspects. The *Criteria for the Classification and Diagnosis of Heart Disease,* published by The New York Tuberculosis and Health Association (Heart Committee) and approved by the American Heart Association has been used as a basic guide.

The medical literature for the past twenty years does not abound with studies of this subject[1-31] and none of them has pursued a uniform set of standards for the diagnosis and classification of the cases of heart disease which they include. The difficulty of obtaining a large enough number of cases in any one series to be statistically significant is well known. The only hope of providing conclusions which approach the truth probably lies in combining the experience of several hospitals and this is a faint hope indeed if uniform standards are not adhered to. It is to be hoped that others interested in this subject may approve this set of standards and assemble their experience in a similar way, thus providing the very essence of statistical accuracy which is "numbers." No claim of statistical infallibility is made for many percentage figures in this study. The standard error of the difference is more than one-half the actual difference in most instances. It is hoped that the addition of more cases from this or other institutions will ultimately strengthen the significance of all these figures.

RHEUMATIC HEART DISEASE

The requirements for inclusion in the rheumatic heart disease group of cases are those recommended by the American Heart Association: (1) a history of any of the manifestations of rheumatic fever (polyarthritis, chorea, muscle or joint pains, subcutaneous nodules) and (2) evidence of a characteristic structural lesion of the heart (carditis, cardiac valvular disease, adherent pericardium).

There were 150 patients answering these requirements and they were subjected to 189 operations. There were 7 deaths in the immediate postoperative period, a mortality of 3.7 per cent.* In addition there were 7 cardiorespiratory complications, a rate of 3.7 per cent. These complications are potential mortalities and should be calculated as a definite part of the operative risk. For this reason the term "risk rate" has been used in this work and is simply the sum of the mortality and complication rates (Table I).

TABLE I. "RISK RATE" IN PATIENTS WITH HEART DISEASE

	RHEUMATIC	ARTERIO-SCLEROTIC	SYPHILITIC	TOTAL
Number of patients	150	311	17	478
Number of operations	189	485	27	701
Number of deaths	7	72	3	82
Mortality rate	3.7%	14.8%	11.1%	11.6%
Number of complications	7	21	3	31
Complication rate	3.7%	4.3%	11.1%	4.4%
Risk rate	7.4%	19.1%	22.2%	16%

A comparison of the mortality rates in certain groups of operations on patients with heart disease with our general mortality for the same type of case is of interest. In this series of patients with rheumatic heart disease there were 18 thyroidectomies for toxic goiter and 6 for nontoxic goiter. One death occurred (in a patient with nontoxic goiter) from atelectasis, a mortality rate of 4.2 per cent. Our general mortality for thyroidectomy is 1.4 per cent. There were 16 appendectomies for acute appendicitis, 16 for chronic appendicitis, and 1 appendectomy with drainage for acute appendicitis with perforation. Two deaths occurred in this group. One patient had chronic appendicitis and died suddenly of unknown cause. The other had acute appendicitis with perforation and died on the fifth postoperatice day of heart failure. This was a mortality of 6.1 per cent. Our general mortality is 0.9 per cent among all cases of appendicitis. Of the other common operations there were 10 cholecystectomies, 14 hernioplasties, and 15 operations for hemorrhoids and fistulas in ano, all without a death.

The thought has been repeatedly expressed that the heart that is able to carry out its function in everyday life will add no risk to any surgery which may be contemplated. In the rheumatic group this aphorism is true; for the mean functional classification (see Table II) was significantly higher in the mortality group than it was in the complicated and uncomplicated group. In

*The mortality and complication rates are uniformly calculated on the basis of the number of operations rather than the number of patients. Where a patient has undergone more than one operation it is considered that he submits to a new risk each time.

TABLE II. INFLUENCE OF CARDIAC FUNCTION, AGE AND OPERATING TIME ON THE SURGICAL "RISK RATE" IN PATIENTS WITH RHEUMATIC HEART DISEASE

	MEAN FUNCTIONAL CLASSIFICATION	MEAN AGE (YR.)	MEAN OPERATING TIME (MIN.)
No complications	1.4	30	70
Complications	2.1	39	93
Died	2.6	43	63

Mean Functional Classification

Class I. Patients with cardiac disease and *no limitation of physical activity;* ordinary physical activity does not cause discomfort

Class II. Patients with cardiac disease and *slight limitation of physical activity;* they are comfortable at rest but on ordinary physical exertion experience discomfort in the form of undue fatigue, palpitation, dyspnea, or anginal pain

Class III. Patients with cardiac disease and *marked limitation of physical activity;* they are comfortable at rest but the above symptoms are caused by less than ordinary activity

Class IV. Patients with cardiac disease who are *unable to carry on any physical activity without discomfort;* symptoms of cardiac insufficiency or of the anginal syndrome are present, even at rest

addition, 57 per cent of the mortality group were patients from Class III or Class IV, while only 6.3 per cent of the uncomplicated group were from Class III. There were no patients in Class IV who survived operation without complication. This is evidence of the importance of classifying this type of heart disease on a functional basis. As will be seen later, the mortality rate in other types of heart disease bears no such consistent relation to the functional classification.

Concerning age, reference to Table II will support the view that the older rheumatic patients present an increased risk for surgery. In the mortality and complication groups there were only two patients under 33 years of age. Those who died were all over 33 years.

It has been repeatedly said and written that rapidity in the performance of the surgical procedure is of the utmost importance in the treatment of surgical patients with heart disease. That any relationship exists between speed in operating and good results cannot be shown in this series (Table II). If anything, it would seem that one should be even more meticulous in dealing with cardiac patients. The anesthesiologist, who can administer high concentrations of oxygen and even breathe for the patient if necessary, is very well equipped to handle faltering hearts. That a rapid and easy convalescence is the important factor is borne out by the fact that the mortality of surgery on cardiac patients rarely occurs in the operating room. Sudden death, associated with surgery, is much more common among noncardiac patients than it is among those with a cardiac complication.

There were 19 patients (22 operations) with auricular fibrillation in the rheumatic group. Of these, 4 died and 4 had postoperative cardiorespiratory complications (Table III). From another aspect, auricular fibrillation was present in 57 per cent of the mortality group, in 57 per cent of the complication group, and in 8 per cent of the uncomplicated group. The increased risk of surgery in patients with fibrillating rheumatic hearts is obvious and the inference of delaying elective surgery and attempting to restore a normal sinus rhythm is equally clear.

Cardiac enlargement was present in 75 patients who were subjected to 108 operations. There were 7 deaths, a rate of 6.5 per cent, and 6 complications, a rate of 5.6 per cent (Table III). From another point of view, cardiac enlargement was present in 100 per cent of the mortality group, in 86 per cent of the group with complications, and in only 54 per cent of uncomplicated cases. These data suggest that an enlarged heart may increase the risk of surgery in rheumatic heart disease, although it is not as striking a factor as auricular fibrillation.

Mitral stenosis was diagnosed in 108 patients who underwent 147 operations. There were 7 deaths and 6 complications, rates of 4.8 per cent and 4.1 per cent, respectively (Table III). Mitral stenosis was present in 100 per cent of the mortality group, in 86 per cent of the complication group, and in 71 per cent of the uncomplicated group. Here again is a factor which appears to increase the operative risk, albeit to a lesser extent than those previously recorded.

The combined presence of auricular fibrillation, enlarged heart, and mitral stenosis produces a risk rate which is not the sum of the rates for each factor but rather a reflection of the rate of the most important one, that is auricular fibrillation. The same thing can be said for the combination of enlarged heart and mitral stenosis (Table III).

Concerning the combined presence of aortic and mitral lesions, there seems to be no significant increase in the risk rate. There were 35 such cases (41 operations) with 2 deaths and 1 complication for rates of 4.9 per cent and 2.4 per cent, respectively (Table III).

TABLE III. INFLUENCE OF VARIOUS FACTORS ON THE RISK OF SURGERY IN PATIENTS WITH RHEUMATIC HEART DISEASE

	(1) AURICULAR FIBRILLATION	(2) CARDIAC ENLARGEMENT	(3) MITRAL STENOSIS	(4) COMBINATION OF 1, 2 & 3	(5) COMBINATION OF 2 & 3	(6) AORTIC PLUS MITRAL LESION
Number of operations	22	108	147	20	98	41
Number of deaths	4	7	7	4	7	2
Mortality rate	18.1%	6.5%	4.8%	20%	7.1%	4.9%
Number of complications	4	6	6	4	5	1
Complication rate	18.1%	5.6%	4.1%	20%	5.1%	2.4%
Risk rate	36.2%	12.1%	8.9%	40%	12.2%	7.3%

To summarize, the risk of surgery appears to be enhanced in rheumatic patients by auricular fibrillation, cardiac enlargement, mitral stenosis, age, and a high functional classification. No relationship to risk could be demonstrated for operating time or the combined presence of aortic and mitral lesions.

ARTERIOSCLEROTIC HEART DISEASE

For inclusion in this group of cases it has been required that the patient present signs or symptoms of cardiac abnormality (for example, enlarged heart, previous episode of failure, previous coronary occlusion, anginal

attacks, abnormal dyspnea, orthopnea, etc.) without a history of rheumatic fever, syphilis, or thyroid disease, and supported by at least one characteristic clinical finding (for example cardiac enlargement shown by x-ray examination, electrocardiographic changes, or congestive heart failure. Post-mortem evidence of coronary sclerosis, definite electrocardiographic findings (for example, inverted T waves, diphasic T waves, or auricular fibrillation or flutter and heart block in the absence of other etiologic possibilities) have been accepted as proof of the disease without requiring any symptoms. People with symptoms of heart disease and no other more specific findings of cardiac arteriosclerosis were not included.

Three hundred eleven patients were found to answer these requirements and they were subjected to 485 operations. There were 72 deaths and 21 post-operative cardiorespiratory complications for rates of 14.8 per cent and 4.3 per cent, respectively (Table I). Of these arteriosclerotic patients, 19 per cent failed to survive operation without complication.

TABLE IV. COMPARISON OF GENERAL MORTALITY RATES WITH MORTALITY RATES IN ARTERIOSCLEROTIC HEART DISEASE

OPERATION	GENERAL MORTALITY RATE		ARTERIOSCLEROTIC MORTALITY RATE	
	PER CENT	NUMBER OF OPERATIONS	PER CENT	NUMBER OF OPERATIONS
Thyroidectomy	1.4	1650	8	25
Biliary	2.6	1931	8.3	24
Hernioplasty	0.57	2615	3.1	32
Amputation	6.7	313	30	20
Incision and drainage of abscess	2	1290	13.6	22
Excision of carbuncle	6	167	50	6
Colostomy	15	348	20	15
Transurethral prostatectomy	3.9	412	10	50
Suprapubic prostatectomy	8.1	272	39	23
Perineal prostatectomy	1.5	68	11.8	17
Suprapubic cystostomy	32	71	23	35
	7.5%		19%	

In Table IV the mortality rates in arteriosclerotic heart disease are compared with our general mortality rate for the same type of operation. The rather high mortality rates in the common operations for prostatism are worthy of note.

A comparison of Table V with Table II will show two interesting differences between patients with arteriosclerotic heart disease and those with rheumatic heart disease. In the first place the arteriosclerotic heart may be doing its everyday work quite well only to fail under the stresses of surgery, while the rheumatic heart producing few or no symptoms adds no risk under these circumstances. In the second place older arteriosclerotic patients do not appear

TABLE V. INFLUENCE OF CARDIAC FUNCTION, AGE, AND OPERATING TIME ON THE SURGICAL "RISK RATE" IN ARTERIOSCLEROTIC HEART DISEASE

	MEAN FUNCTIONAL CLASSIFICATION	MEAN AGE (YR.)	MEAN OPERATING TIME (MIN.)
Uncomplicated	1.8	63	80
Complicated	1.6	59	75
Died	1.9	65	71

to present any increased risk for surgery, whereas patients with rheumatic heart disease in the older age groups are definitely poorer risks. Table V shows only one similarity to Table II, that is, no relationship between operating time and the results of surgery could be demonstrated.

Among the arteriosclerotic group there were 62 patients with auricular fibrillation, 6 with auricular flutter, and 1 with nodal rhythm. These patients presented the highest mortality and complication rates, as shown in Table VI.

TABLE VI. INFLUENCE OF VARIOUS FACTORS ON THE RISK OF SURGERY IN PATIENTS WITH ARTERIOSCLEROTIC HEART DISEASE

	ABNORMAL RHYTHM	CARDIAC ENLARGEMENT	HEART BLOCK	PREVIOUS CORONARY OCCLUSION	HISTORY OF ANGINA
Number of operations	87	315	105	37	58
Number of deaths	16	40	13	3	5
Mortality rate	18.4%	12.7%	12.4%	8.1%	8.6%
Number of complications	9	11	8	1	1
Complication rate	10.4%	3.5%	7.6%	2.7%	1.7%
Risk rate	28.8%	16.2%	20%	10.8%	10.3%

Cardiac enlargement was present in 196 patients who had 315 operations. The majority of these patients had this diagnosis confirmed by x-ray examination. The mortality and complication rates are shown in Table VI.

There were 65 patients with heart block in this series of arteriosclerotic heart disease and they included the following varieties: left bundle branch block (discordant) 6; left bundle branch block (concordant), 6; right ventricular block, 21; Intraventricular block, 11; left intraventricular block, 2; bundle branch block (wide S wave), 3; incomplete block (P-R/0.28 – 0.39), 2; bundle branch block, 1; 2:1 block, 1; prolonged P–R interval, 10; prolonged Q–R–S (.11), 1.

The mortality and complication rates are shown in Table VI.

Definite historical or post-mortem evidence of a previous coronary occlusion was obtained in 25 patients who were subjected to 37 operations. Three deaths occurred in this group, a rate of 8.1 per cent. One patient died of a second coronary occlusion, one of heart failure and pneumonia, and one after a prolonged period of fever and tachycardia without adequate explanation. The single complication was a coronary occlusion which the patient survived (Table VI).

A history of angina of effort was elicited in 41 patients who underwent 58 operations. There were 5 mortalities, a rate of 8.6 per cent. One patient had an episode of heart failure after the first operation and finally died of uremia after a second operation. Heart failure and pulmonary infarction accounted for the death of 2 patients, and 2 others had fresh coronary occlusions, confirmed at autopsy. The single patient with a complication in this group suffered a pulmonary infarction.

If elevation of the blood pressure was a factor increasing the risk of surgery one would expect that hypertension would be present to a greater degree in the mortality and complication groups than in the uncomplicated

group. That it is not a factor can be seen from Table VII. The percentage of patients in which hypertension was recorded is about the same in the three groups.*

TABLE VII. INFLUENCE OF HYPERTENSION ON THE RISK OF SURGERY IN PATIENTS WITH ARTERIOSCLEROTIC HEART DISEASE

BLOOD PRESSURE	DEATHS		COMPLICATIONS		UNCOMPLICATED CASES	
	PERCENTAGE	NUMBER OF CASES	PERCENTAGE	NUMBER OF CASES	PERCENTAGE	NUMBER OF CASES
150/ 90	48.5	35/72	57.2	12/21	57.7	126/218
200/100	13.9	10/72	4.8	1/21	12.4	27/218

In an effort to find some danger line of renal function for patients with arteriosclerotic heart disease, various combinations of the blood urea nitrogen, phenolsulfonphthalein and albumin excretion rates were tested against these 311 patients. The combination showing the greatest difference between the mortality group and the uncomplicated cases was a blood urea nitrogen of 20 or more, or a phenolsulfonphthalein of 50 or less, or, albuminuria of 2+ or more. This criterion of renal function was answered by 45 per cent of the deaths, 26 per cent of the complications, and only 11 per cent of the uncomplicated cases. Stated in another way, 41 per cent of the deaths and complications had one or more of these evidences of poor renal function as against 11 per cent for the uncomplicated group.

In summary, patients with arteriosclerotic heart disease show a mortality rate four times that of rheumatic heart disease. In this disease, the heart which is doing a satisfactory day-to-day job cannot be depended upon to withstand surgery. Abnormalities of rhythm and poor kidney function appear to enhance the surgical risk. No definitely increased risk could be demonstrated for patients with cardiac enlargement, heart block, previous coronary occlusion, angina pectoris, or hypertension. No relationship could be established between the risk of surgery and the patient's age or the time consumed in performing the surgical procedure.

SYPHILITIC HEART DISEASE

Our experience in the surgical treatment of patients with syphilitic heart disease has been very limited. There were 17 patients who had 27 operations. All of these except 2 had a 4 plus Wassermann reaction and a widened aorta confirmed by x-ray examination. Of these 2 one had a 4 plus Wassermann reaction, but no roentgenogram was taken. However, syphilitic aortitis was proved at post-mortem examination. The other had a negative Wassermann reaction, but did have a wide aorta on x-ray examination plus tabes dorsalis and a neurogenic bladder. Nearly all of the patients in this group had other signs of syphilitic heart disease.

There were 3 deaths and 3 cardiorespiratory complications for identical mortality and complication rates of 11.1 per cent.

*During the period covered by this study 165 operations were performed for the relief of essential hypertension with 5 deaths, for a mortality rate of 3 per cent.

The mean functional classification for the uncomplicated group was 1.4, for the group with complications 2.0, and for those who died 1.3. In the same order the mean age in years was 60, 61, and 60, and the mean operating time in minutes 56, 70, and 72 (Table VIII).

There were 5 patients with angina, 1 of whom died and 2 of whom had postoperative complications.

TABLE VIII. INFLUENCE OF CARDIAC FUNCTION, AGE, AND OPERATING TIME ON THE SURGICAL "RISK RATE" IN SYPHILITIC HEART DISEASE

	MEAN FUNCTIONAL CLASSIFICATION	MEAN AGE (YR.)	MEAN OPERATING TIME (MIN.)
Uncomplicated	1.4	60	56
Complicated	2.0	61	70
Died	1.3	60	72

There were 3 cases of heart block with 2 complications.

There were 2 patients with combined heart block and angina and they both went into congestive heart failure during the postoperative period but survived.

There were no sudden deaths during any of the 27 operative procedures.

Seven of the 14 survivors were dead within two years.

The mortality and complication rates which we experienced in this series for various anesthetic agents are detailed in Table IX. The only two sets of figures which are of statistical significance, as determined by calculation of the standard error, are the rates for local and spinal anesthesia. This significance is probably vitiated by the weighting of the local anesthesia group with operations of relatively minor severity. A comparison of spinal with all types of inhalation anesthesia barely misses falling into numerical significance and in this group the weighting of prolonged and serious operations would be in the reverse direction.

It is probably safe to say that local anesthesia should be used when feasible and that spinal should be avoided if possible. It should be emphasized, however,

TABLE IX. ANESTHESIA—INFLUENCE OF CHOICE OF ANESTHESIA ON THE RISK OF SURGERY IN RHEUMATIC, ARTERIOSCLEROTIC, AND SYPHILITIC HEART DISEASE

	OPERATIONS		DEATHS		COMPLICATIONS		RISK RATE
	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	
Local	277	39.6	26	8.9	9	3.2	12.1
Spinal	150	21.4	26	17.3	7	4.7	22.0
Caudal	21	3.0	1	4.8	0	0	4.8
Open ether	99	14.1	14	14.2	3	3.2	17.4
Nitrous oxide oxygen and ether	58	8.3	6	10.3	1	1.7	12.0
Cyclopropane	32	4.6	1	3.1	5	15.6	18.7
Ethylene	9	1.2	2	22.2	0	0	22.2
Ethylene and ether	14	2.0	0	0	1	7.1	7.1
Nitrous oxide and oxygen	10	1.4	3	30.0	1	10.0	40.0
Local plus general	10	1.4	3	30.0	1	10.0	40.0
Avertin	14	2.0	0	0	3	21.4	21.4
Rectal ether	7	1.0	0	0	0	0	0
All inhalation anesthesias	232	33.1	29	12.5	12	5.2	17.7

that the reported differences, even if significant, are small. No evidence has been found in this series to refute the general rule that the choice of the anesthetist is more important than the choice of the anesthetic agent.

Table X presents the causes of deaths and the type of complications. In 45 per cent of the 82 deaths in this study there were post-mortem examinations.

TABLE X. CAUSES OF DEATHS AND NATURE OF COMPLICATIONS AMONG 478 PATIENTS WITH HEART DISEASE WHO UNDERWENT 701 OPERATIONS

	RHEUMATIC HEART DISEASE	ARTERIOSCLEROTIC HEART DISEASE	SYPHILITIC HEART DISEASE
Deaths			
Atelectasis	1		
Mycotic brain abscess	1		
Pneumonia	2	14	1
Unknown	1	4	
Heart failure	1	23	
Arterial embolus	1	1	
Brain contusion		1	
Pulmonary embolus		5	
Cerebral hemorrhage		2	
Vascular collapse		4	
Peritonitis		3	
Dissecting aneurysm		2	
Coronary occlusion		9	
Liver necrosis		1	
Carcinomatosis		1	
Agranulocytosis		1	
Thyroid crisis		1	
Mesenteric thrombosis			1
Cirrhosis			1
Complications			
Heart failure	5	6	2
Pneumonia		2	1
Coronary occlusion		5	
Auricular tachycardia		1	
Pulmonary embolus	1	3	
Vascular collapse		1	
Auricular fibrillation		3	
Arterial embolus	1		

CONCLUSIONS

1. The risk of surgery in rheumatic heart disease is not great. What risks there are seem to center in certain types of patients with rheumatic heart disease, namely, those over 33 years of age, those with fibrillation, and those with a high functional classification.

2. The risk of surgery in arteriosclerotic heart disease is considerably greater and seems to be centered in the etiologic diagnosis. It does not appear to be significantly modified by the various anatomic, physiologic, or functional factors except that disorders of cardiac rhythm and poor renal function produced higher "risk rates" in our experience.

3. The risk of surgery in syphilitic heart disease cannot be accurately determined in the small number of cases available. However, the evidence suggests that the risk is less than in arteriosclerotic heart disease but greater than in rheumatic heart disease. The presence of angina and/or heart block adds to the risk of surgery in patients with syphilitic heart disease.

4. No single anesthetic agent is definitely superior for patients with heart disease. However, it seems that local anesthesia should be used if feasible and spinal anesthesia avoided if possible.

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ESOPHAGOGASTROSTOMY IN THE TREATMENT OF CARDIOSPASM

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PERIODICALLY during the past thirty years dissatisfaction with the nonoperative methods of treating patients with cardiospasm has found expression in the development of various surgical measures directed toward relief of the constriction at the gastric cardia. Until recently, however, none of these methods has received any very enthusiastic reception, doubtless due to the high mortality which was expected to follow any operative procedure involving open esophagotomy; fatal postoperative infections were too frequently the rule. With the development of chemotherapy it has become evident that the esophagus can be attacked surgically with far greater confidence than ever before. Furthermore, as the operations for cancer of the esophagus and the gastric cardia have been developed, surgeons have discovered that esophageal surgery can be undertaken with relative safety and that this organ per se is not the formidable structure it was once considered. For these two reasons, therefore, it might have been anticipated that the question of how to deal surgically with patients with intractable cardiospasm would again be brought into focus. Because reported cases in which the patient has been operated upon are relatively rare, and because the results obtained in eight patients in this clinic have been gratifying, there has seemed ample justification for reporting even this relatively small series.

Benign nonorganic obstruction of the esophagus at the gastric cardia is a clinical syndrome which was first recognized by Willis in the seventeenth century. Since its original description, this disease entity is one to which a bewildering variety of terms has been applied and one in which no definite etiologic agent has as yet been defined. In all probability the obstruction is due to organic factors which are intrinsic in the cardia and to its autonomic nerve supply. Also, it seems certain that all the individuals with cardiospasm present varying degrees of emotional instability and that frequently their symptoms bear an almost direct relationship to periods of stress and tension.

Although a great many of these patients can be carried along with reasonable success by explaining to them the nature of their difficulty and by means of peroral dilatation, every large clinic presents a group of these individuals in whom such conservative measures fail. These unfortunates, as they wander from doctor to doctor over long periods of time without obtaining any permanent improvement, progressively develop a tortuous, elongated, and dilated esophagus. Finally, the obstruction fails to respond more than temporarily to any form of conservative treatment. It is those patients who are finally considered subjects for direct operative intervention.

The various types of surgical procedures which have been advocated have been so completely and competently reviewed by Ochsner and DeBakey[1] in their

excellent review that there is no need for repetition here. In seven cases in this series of eight, the obstruction at the gastric cardia has been overcome by means of an esophagogastrostomy devised by Grondahl[2] as a modification of Heyrovsky's[3] original procedure. In principle this operation is entirely comparable to the Finney[4] gastroduodenostomy which at one time enjoyed wide popularity as a cure for pyloric obstruction. In one patient (Case 6) the gastric cardia was generously incised in its longitudinal axis. By closing this incision transversely the constriction was corrected. Figs. 1 to 6 demonstrate diagrammatically these two types of operative procedure.

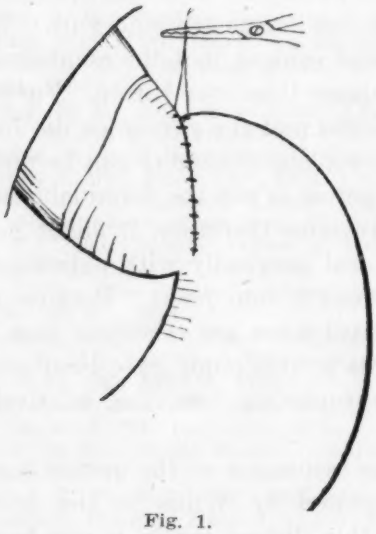


Fig. 1.

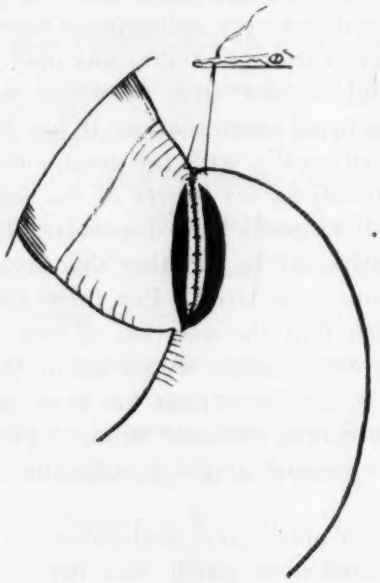


Fig. 2.

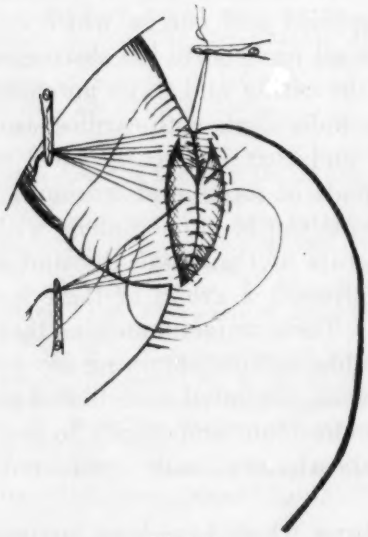


Fig. 3.

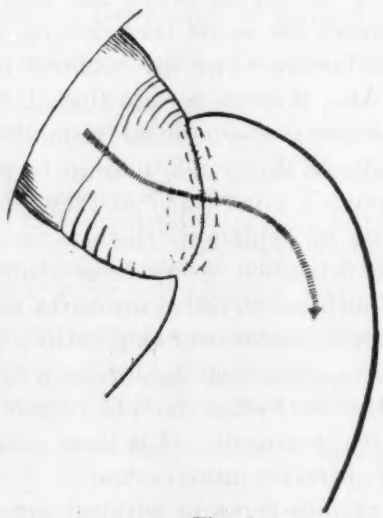
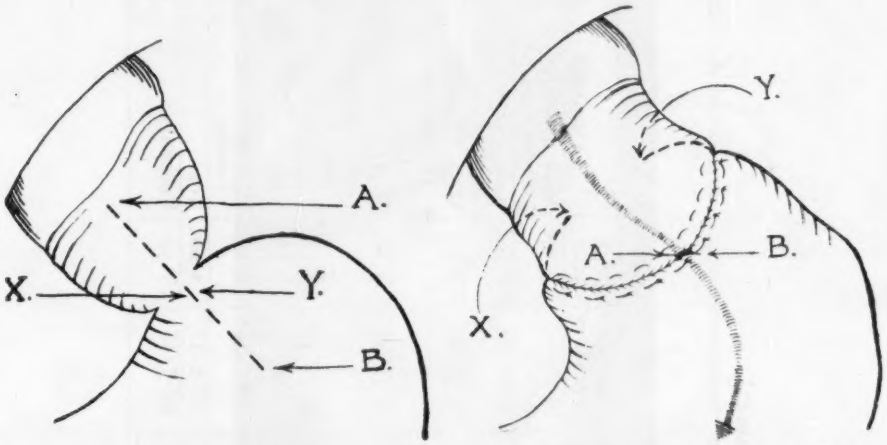


Fig. 4.

Figs. 1, 2, 3, and 4.—Diagrammatic representation of the successive steps employed in performing the esophagogastrostomy in Cases 1, 2, 3, 4, 5, 7, and 8. This closely resembles the well-known Finney pyloroplasty.

In two of these nine operations the lower esophagus and gastric cardia were approached transabdominally; in five the operation was performed transthoracically; in one patient (Case 2) requiring a second operation the first was done through the abdomen, while at the second, access to the area was obtained through the chest. All nine operations were performed without a death and with only one significant postoperative complication; the first patient in this series developed an empyema after transthoracic esophagogastrostomy. Following suitable thoracotomy for drainage, this girl improved rapidly and is now well save for a small pleural fistula. In view of the seriousness of this complication when it occurs, and the ease with which the esophageal-gastric



Figs. 5 and 6.—Diagrammatic representation of the method employed in relieving the esophagogastric constriction in Case 6. The principle involved is that of opening a tubular structure longitudinally and closing it transversely, thereby eliminating a diaphragm-like constriction.

junction was approached from below the diaphragm in three instances, we favor the transabdominal approach. In all of the patients in this series chemotherapy was employed in the early postoperative period. The significant facts in each of these cases are outlined in Table I. Abbreviated case reports are presented, together with unretouched reproductions of the pre- and postoperative roentgenograms.

CASE REPORTS

Case 1 (N. Y. H. No. 388704).—C. D., a 28-year-old married woman, was first seen at this hospital in September, 1944, approximately two years after the onset of the chief complaint of difficulty in swallowing. At this time roentgenograms of the esophagus failed to reveal any definite obstruction or dilatation, but there was a suggestion of constriction at the cardiac orifice of the stomach. Esophagoscopy failed to reveal any apparent organic stricture, but a biopsy taken from the lower third demonstrated on microscopic examination a mild degree of leucoplakia. Following the initial visit this patient attended the general medical and psychiatric clinics without improvement until June, 1947, about three years later, or five years after the onset of the complaints. At this time esophagograms revealed marked dilatation of the esophagus with constriction at the cardiac orifice of the stomach. Psychiatric consultation early in the course of the disease yielded the impression that "the patient seems fairly well adjusted."

Since it was felt that this patient had been given adequate opportunity to recover under a conservative regime and had not only failed to improve but had become progressively worse, she was admitted for surgical treatment. She had not been subjected to instrumental

TABLE I

NO.	N. Y. H. HIST. NO.	SEX	AGE (YR.)	DURATION OF SYMPTOMS	WEIGHT LOSS (POUNDS)	DILATATION OF ESOPHAGUS	DATE OF OPERATION	FOLLOW-UP			POSTOPERATIVE ROENTGENOGRAMS	
								DURATION	SYMPTOMS	WEIGHT GAIN (POUNDS)	DILATATION OF ESOPHAGUS	FUNCTION OF ANASTOMOSIS
1	388704	F	28	5 yr.	None	None (1944) Marked (1947)	6/20/47	6 mo.	Mild dysphagia under tension	10	None	Excellent
2	345435	M	19	2 yr.	30	Moderate (1942)	6/11/43	7 mo.	Severe cardiospasm	None	Marked	Failure
			20	2 yr. 7 mo.		Marked (1943)	2/23/44	4 yr.	Mild substernal fullness after eating	None	Minimal	Excellent
3	167879	M	51	30 yr.	None	Marked (1941, 1945, 1947)	4/18/47	6 mo.	Mild; no nocturnal regurgitation	None	None	Excellent
4	206158	F	51	4 yr.	None	Minimal	8/21/47	3 mo.	Mild	None	None	Excellent
5	466970	F	25	6 yr.	15	Moderate	1/29/47	10 mo.	None	17	None	Excellent
6	483521	M	34	5 yr.	20	Marked	7/30/47	3 mo.	Dysphagia under tension	15	Moderate	Excellent
7	467001	F	24	5 yr.	30	Moderate	3/ 5/47	8 mo.	None	30	None	Excellent
8	404150	F	59	19 yr.	67	Enormous (1945)	2/ 7/45	3 yr.	Unchanged	See Case Report	Marked	Excellent

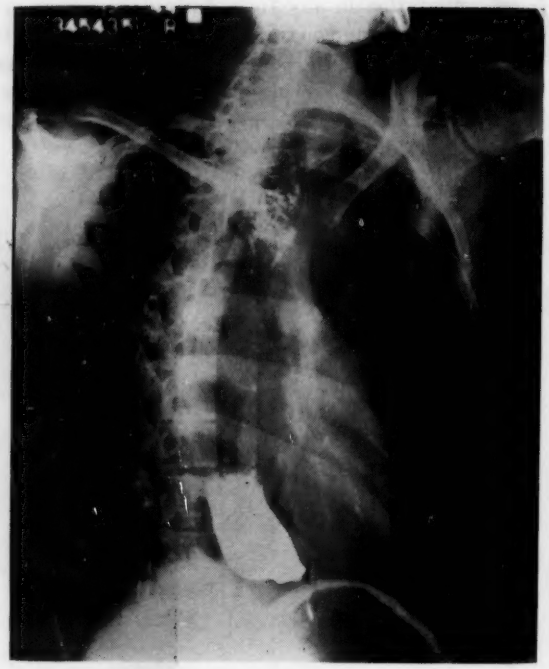
dilatation in any form during the course of the conservative management. On June 20, 1947, an esophagogastrostomy was performed transthoracically. The postoperative course was complicated by the development of an empyema necessitating drainage. Six months postoperatively, the patient was still well. She stated that she had gained ten pounds in weight and was completely free of the most significant preoperative complaint, namely, that of

Fig. 7 (Case 1).—Postoperative film demonstrating excellent function of the esophagogastrostomy. A small tube remains in the empyema sinus tract. (Preoperative films lost in this case.)

nocturnal regurgitation, which was most distressing in that the pillow was constantly soiled by foul esophageal contents. It is of particular interest that even today when the patient is subjected to emotional tension the subjective symptoms reappear without, however, any of the preoperative objective phenomena such as vomiting and regurgitation. Postoperative x-ray examination revealed excellent correction of the defect at the gastric cardia without dilatation of the esophagus. The passage of barium from the esophagus into the stomach was entirely free.

CASE 2 (N. Y. H. No. 345435).—R. B., 19-year-old man was first admitted to the hospital in December, 1942, with a two-year history of difficulty in swallowing. The onset then was gradual but, once started, progression was unremitting so that on admission liquids constituted the only food that the patient was able to take by mouth. He had lost thirty pounds in weight. X-ray examination revealed dilatation of the esophagus terminating in a smooth conical constriction. Esophagoscopy was negative save for a tightly closed gastric orifice which was readily dilated to admit a 9 mm. Jackson esophagoscope. During the course of the following six months this patient was treated conservatively without benefit. Bouginage was employed without sustained improvement. Psychiatric consultation yielded the following impression: "The writer was unable to work out any definite psychogenic factors. . . . However, the patient appears to be one of the rather dull intellectual level who has displayed psychoneurotic reactions."

A.



B.

C.

Fig. 8 (Case 2).—*A*, Roentgenogram taken six months prior to the first operation. *B*, Roentgenogram taken six months after the first surgical attempt to relieve the obstruction and one month prior to the second operation. *C*, Roentgenogram taken three years after the second operation. This demonstrates excellent function of the anastomosis between the stomach and esophagus.

On June 11, 1943, an esophagogastrostomy was performed through an upper abdominal incision. The patient's immediate postoperative course was uneventful but he failed to obtain any improvement in symptoms.

After approximately seven months of ineffectual dilatations, exploration was again done (February, 1944), this time through the left side of the thorax. Upon exposing the site of the previous operative procedure, an area of constriction was found which had apparently not been released at the initial operation. This lay just at the upper border of the previous anastomosis. Again an esophagogastrostomy was undertaken, carefully including the persistent area of stricture. The immediate postoperative course was gratifying and repeated esophagograms revealed a normal esophagus with excellent function at the cardiac end of the stomach.

Four years after the operative procedures, although x-ray studies persistently failed to indicate any obstruction in the distal esophagus, the patient intermittently complained of substernal fullness on eating. Rarely has he vomited. Through all of the treatment and over a period of five years, the patient's weight remained constant; he has not regained the initial weight loss of thirty pounds.

CASE 3 (N. Y. H. No. 167879).—E. P., a 51-year-old man, was admitted to the hospital in April, 1947, with a thirty-year history of difficulty in swallowing. In June, 1941, x-ray pictures revealed marked dilatation of the esophagus with cardiospasm and evidence of a healed duodenal ulcer. During the course of the next six years he was treated conservatively but without bouginage. He failed to improve subjectively though he did not lose weight.

On April 18, 1947, an esophagogastrostomy was performed transabdominally. Because of the presence of a duodenal ulcer both vagi were divided. The immediate postoperative course was unremarkable and postoperative roentgenograms revealed a definite decrease in the size of the esophagus and excellent function of the cardioplasty. The patient, however, failed to gain weight and although he still has numerous vague complaints such as "nervousness" and "constipation," these are no longer associated with dysphagia. Furthermore, he states that he is completely free of the most significant preoperative symptom, that of nocturnal regurgitation which invariably appeared upon lying down.

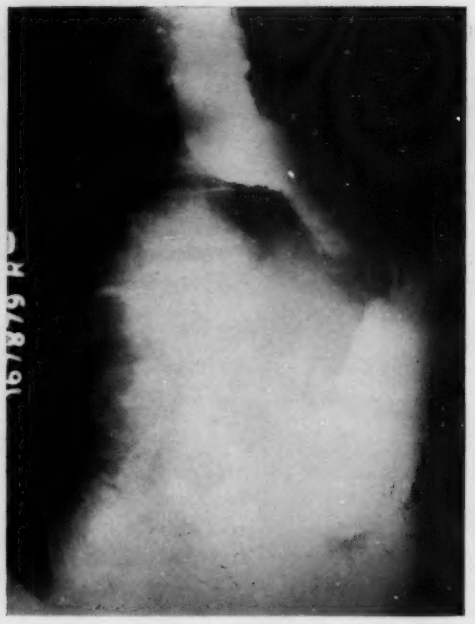
CASE 4 (N. Y. H. No. 206158).—E. B., a 51-year-old woman, might be characterized as one of those patients who presents a "lifetime" history of one complaint or another. The operations included an appendectomy, a hysterectomy, an exploratory celiotomy without significant findings, and a repair of an umbilical hernia. For some four years prior to admission she complained persistently of nausea and vomiting. In the first esophagograms, taken, in 1944, findings were negative. Beginning in 1946, esophagograms began to reveal variable degrees of cardiospasm without dilatation of the esophagus. In 1947 esophagograms revealed cardiospasm with esophagitis. Esophagoscopy at this time revealed marked inflammatory reaction at the lower end of the esophagus. This was confirmed on microscopic examination of a biopsy of the mucosa taken just above the cardiac sphincter.

Aug. 21, 1947, an esophagogastrostomy was performed transthoracically. At this time findings in the esophagus were negative save for a smooth area of constriction at the cardiac orifice of the stomach. The postoperative course was unremarkable and esophageal fluoroscopy has failed to reveal any evidence of obstruction. She is symptom-free.

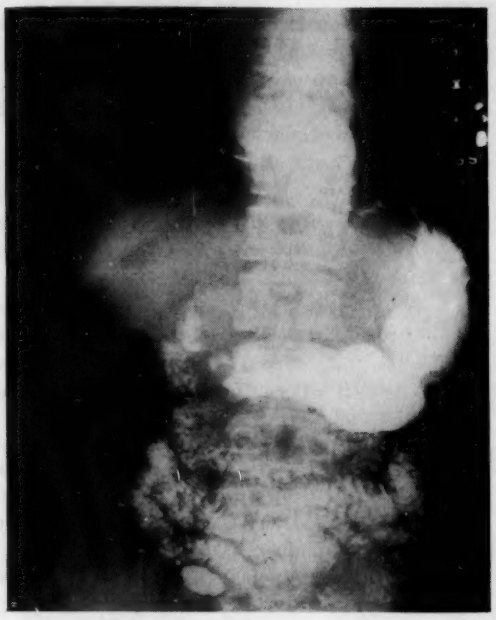
CASE 5 (N. Y. H. No. 466970).—V. A., a 25-year-old woman, was admitted to the hospital in January, 1947, with a six-year history of dysphagia. Following the initial symptoms she was treated medically and dilatation was carried out frequently. The dysphagia increased steadily. Even while under treatment she began losing weight and vomited after almost every meal. Preoperative x-ray pictures revealed a moderately dilated esophagus terminating in a smooth, conical constriction. There was no filling of the stomach after two hours.

On January 29, 1947, an esophagogastrostomy was performed transthoracically. The patient's postoperatvie course was unremarkable.

Six months postoperatively she was without symptoms and the anastomosis between the esophagus and stomach functioned well. She has gained seventeen pounds in weight.



A.



B.

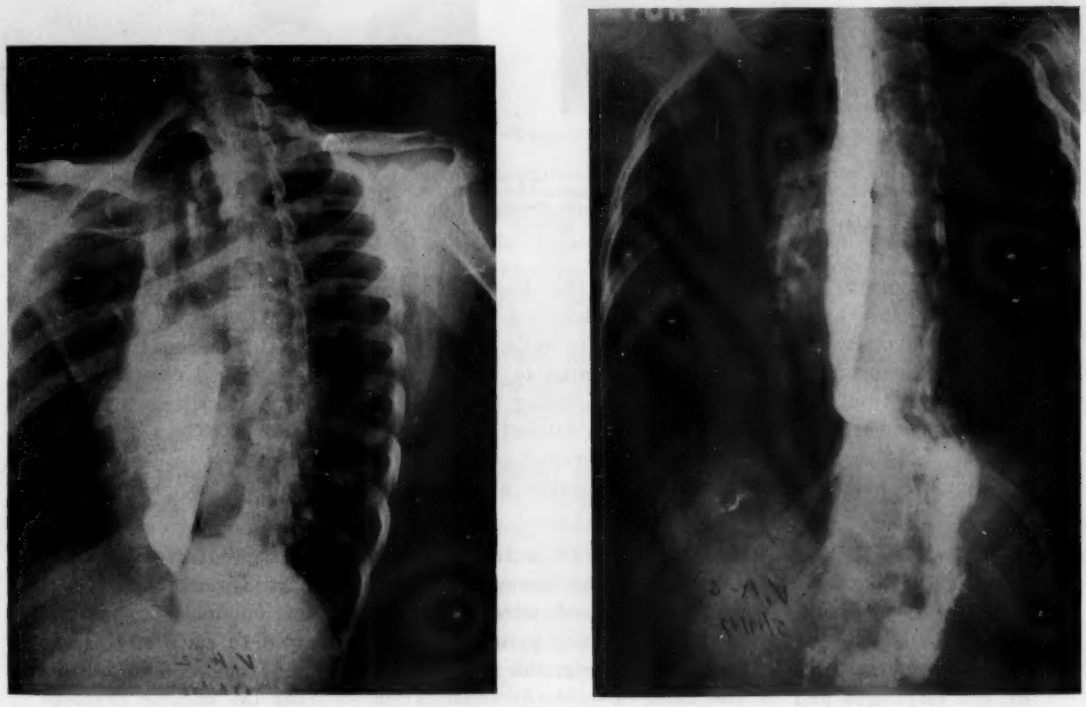
C.

D.

Fig. 9 (Case 3).—*A*, *B*, and *C*, Preoperative esophagograms taken in 1941, 1945, and 1947. These are of interest in that they clearly demonstrate the progressive enlargement of the esophagus which all too frequently is permitted to take place.

D, Postoperative esophagogram revealing excellent function of the esophagogastric anastomosis. This view taken but one month after operation demonstrates remarkable decrease in the diameter of the esophagus.

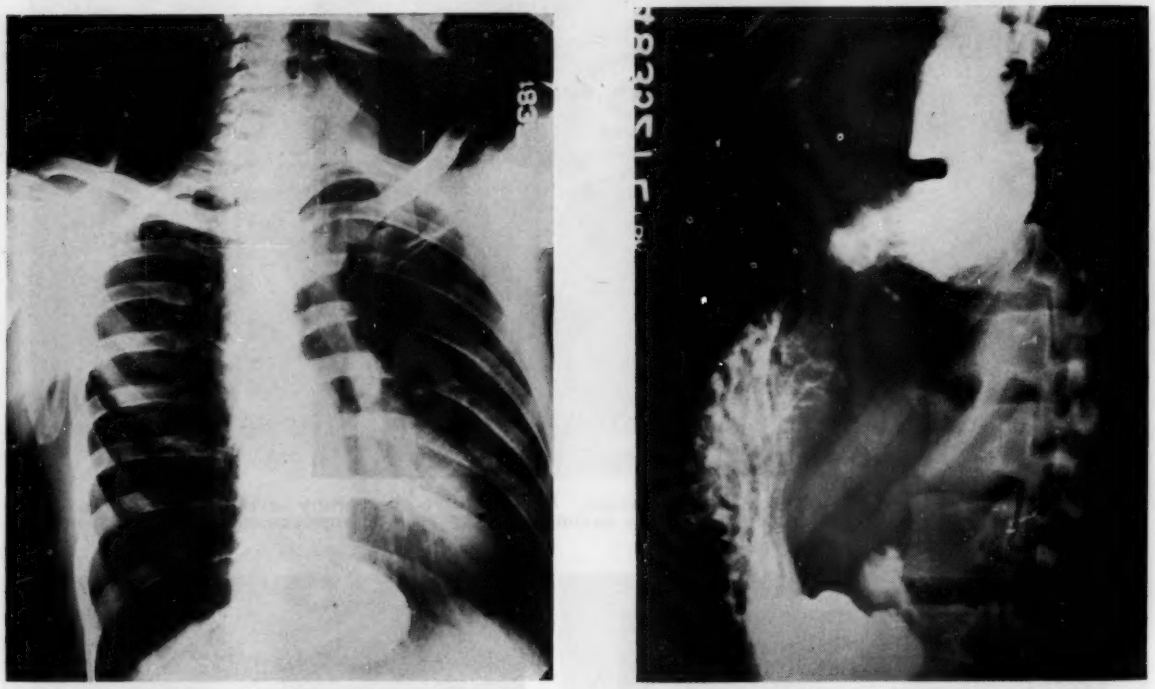
Fig. 10 (Case 4).—Preoperative esophagogram. Postoperative fluoroscopy of the esophagus revealed excellent function with the barium passing promptly into the stomach.



A. *B.*

Fig. 11 (Case 5).—*A*, Preoperative esophagogram revealing moderate dilatation. This view was taken thirty minutes after the swallowing of barium. *B*, Postoperative roentgenogram revealing excellent function and decrease in the dilatation of the esophagus.

CASE 6 (N. Y. H. No. 483521).—E. W., a 34-year-old man was admitted to the hospital in July, 1947, with a five-year history of progressive inability to swallow. Shortly after the onset of symptoms a diagnosis of cardiospasm was made and he was treated by bouginage and formal psychotherapy. Following each series of dilatations he would remain well a month or so and then the difficulty would return. Repeated esophagograms over this period revealed steadily increasing dilatation of the esophagus.



A. *B.*

Fig. 12 (Case 6).—*A*, Preoperative roentgenogram of the esophagus revealing dilatation and tortuosity without passage of barium into the stomach for a period of forty-five minutes. *B*, Postoperative study demonstrating prompt emptying of the esophagus. This view was taken three months after operation and there is as yet little decrease in the size and deformity of the esophagus.

July 30, 1947, the cardiac end of the stomach was explored transabdominally and a smooth stricture at the cardiac orifice identified. A 6 cm. longitudinal incision was made through the anterior esophageal and gastric walls. This was then closed transversely.

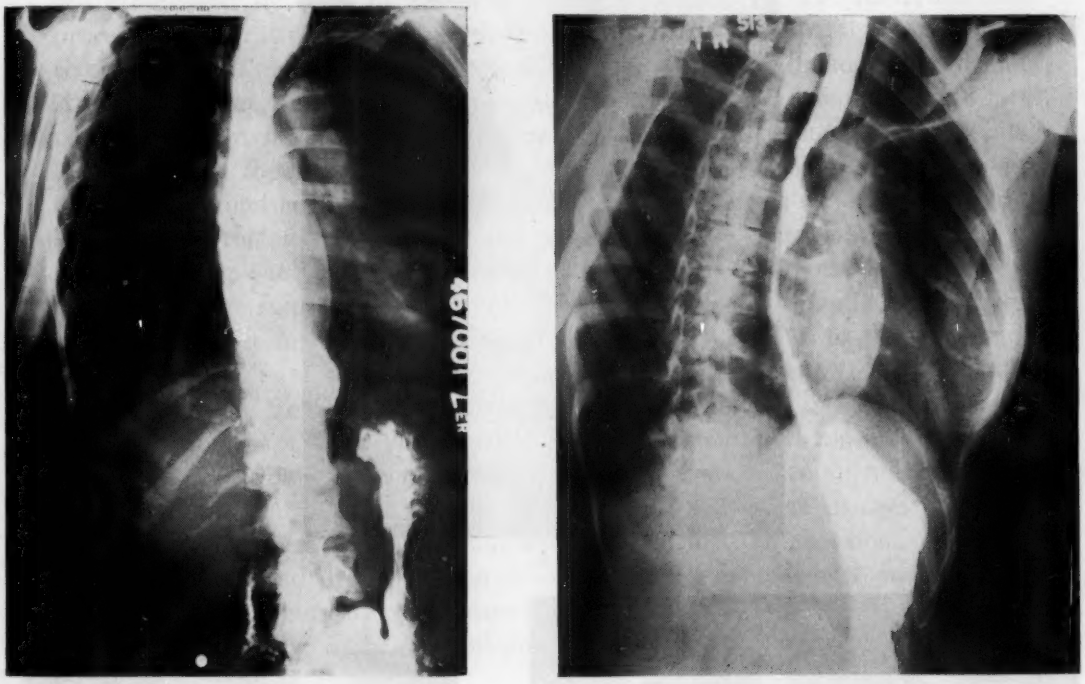
The postoperative course was unremarkable, the patient being discharged from the hospital on the twelfth day after operation, taking a general diet without difficulty.

Three months postoperatively he was without complaint, having gained fifteen pounds in weight. Esophageal fluoroscopy reveals prompt passage of barium from the esophagus into the stomach and roentgenograms demonstrate an adequately functioning esophagogastric junction.

CASE 7 (N. Y. H. No. 467001).—J. D., a 24-year-old woman, was admitted to the hospital in February, 1947, with a five-year history of substernal burning and inability to swallow. During this period she received adequate medical attention including several dilatations of the gastric cardia and a long period of self-bouginage. In spite of this she became progressively worse and esophagograms on admission revealed moderate dilatation of the esophagus and cardiospasm. Psychiatric consultation afforded the opinion that the patient's primary difficulty was an anxiety hysteria and that she would probably respond to prolonged psychotherapy in a psychiatric hospital. In spite of this opinion, operative intervention seemed to be the procedure of choice.

On March 5, 1947, an esophagogastrostomy was performed transthoracically. The postoperative course was uneventful and she was discharged thirteen days after operation.

Her course has been most gratifying. She has gained thirty pounds in weight and esophagograms reveal excellent function of the esophagogastrostomy without dilatation of the esophagus.



A. *B.*

Fig. 13 (Case 7).—*A*, Preoperative esophagogram. *B*, Postoperative esophagogram.

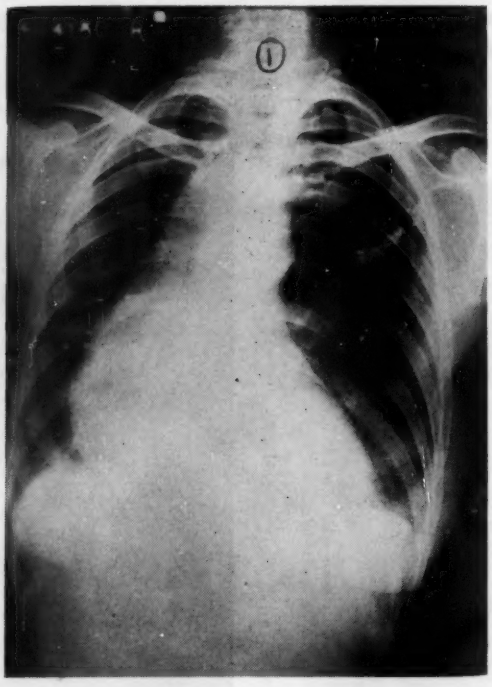
CASE 8 (N. Y. H. No. 404150).—H. C., a 59-year-old woman, entered the hospital in January, 1945, with a nineteen-year history of difficulty in swallowing. She was studied at the onset of the disease and a diagnosis of cardiospasm was made. Dilatations were unsuccessful and she secured no further definitive therapy until eight months prior to admission, when a gastrostomy was performed for feeding purposes. Over the period of nineteen years she lost a total of sixty-seven pounds, thirty of which she gained back following the initiation of gastric feedings. Because she was dissatisfied with the gastrostomy she entered the hospital for any operation which might permit her to eat normally. X-ray pictures taken at the time of admission revealed cardiospasm with extensive dilatation of the esophagus.

On Feb. 7, 1945, an esophagogastrostomy was performed transthoracically. The immediate postoperative course was uneventful, the patient leaving the hospital on the twenty-seventh day after operation. The gastrostomy closed spontaneously.

During the course of the next two years or so follow-up was carried out on this patient at regular intervals and there were two outstanding features worthy of note. First, esophagograms revealed that even though there was rapid passage of barium from the esophagus into the stomach, there was but slight decrease in the preoperative degree of dilatation; and second, that the patient's symptoms were relatively unchanged. She still vomits occasionally and has lost approximately twenty pounds since the operation.

RESULTS

Each of the patients save one was interviewed from six months to two years postoperatively. Several interesting facts appeared. First, most of the patients



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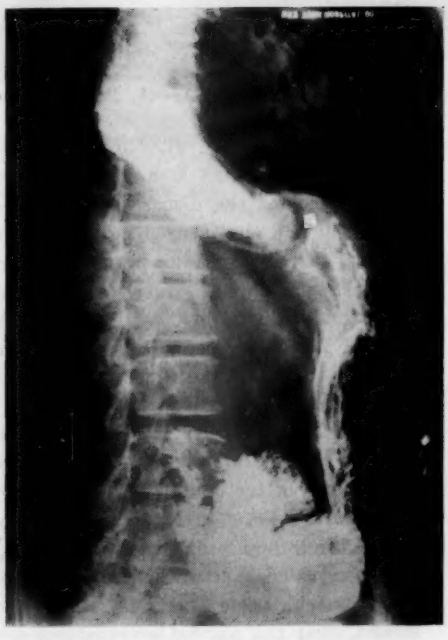

C.

Fig. 14 (Case 8).—*A* and *B*, Preoperative esophagograms revealing marked dilatation and deformity. *C*, Esophagogram two years after operation demonstrating excellent function and a decrease in the diameter but little change in the so-called sigmoid deformity.

have continued to have some untoward symptoms referable either to swallowing or to the upper gastrointestinal tract. For the most part these have been vague but have tended to become intensified during periods of emotional stress. In all instances the patients volunteered that they had been much improved by operation, and in none of those in whom nocturnal regurgitation had been present preoperatively did this distressing problem present itself postoperatively. Second, in all instances final postoperative roentgenography demonstrated excellent function of the esophagogastrostomy, the barium sulfate meal passing without hesitation from the esophagus into the stomach. We are at a loss to explain the persistence of symptoms in the face of such definite evidence of excellent function other than to suggest that possibly the syndrome of cardiospasm affects the entire esophagus and not merely its diaphragmatic orifice.

Excluding the problem of symptomatology, these patients have been improved in other respects. In five out of the eight patients there has been a very appreciable gain in weight, varying from two and one-half to thirty pounds. Three, however, have failed to gain weight, and in one patient (Case 2) none of the preoperative weight loss of thirty pounds was regained in spite of satisfactory function at the gastric cardia. In the seven patients in whom the esophagus was dilated and elongated there has been return to normal in five cases, moderate shrinkage in one, and practically no change in one. This last patient (Case 8) was 59 years of age and demonstrated an enormous esophageal dilatation which had probably been developing for some fifteen to twenty years. Certainly of real economic significance is the fact that all of these patients have been saved expensive and time-consuming office or clinic visits for repeated and ineffectual treatments.

It is concluded, therefore, from reviewing this series of eight patients, that the safety with which esophagogastrostomy can be performed today entitles the procedure to a definite place in the treatment of cardiospasm. Furthermore, it would seem reasonable to accept the general principle that in many instances this type of definitive therapy should be recommended earlier than it has been heretofore. By reserving surgical intervention for only intractable cases, a large group of patients is forced to put up with a certainly unpleasant, if not actually dangerous, train of events much longer than there is any need. Also, where the dilatation has been allowed to persist for many years (as in Case 8), the surgical result cannot be expected to be as satisfactory as it apparently is in those patients in whom operation is performed reasonably early after the onset of symptoms. Seemingly such an overstretched organ loses its power to return to normal and its very dilatation and elongation persist to become as much a basis for symptoms as was the original cardiospasm.

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EVALUATION OF SKIN GRAFTING IN THE TECHNIQUE OF RADICAL MASTECTOMY IN RELATION TO FUNCTION OF THE ARM

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WHILE the primary purpose of radical mastectomy is the cure of mammary carcinoma it is also of importance that satisfactory function of the arm be maintained. This accessory aim is all the more important in view of the high percentage of cases of carcinoma of the breast which are cured by radical mastectomy. The purpose of this report is to present data giving information on the quality of function of the arm in patients who have been treated for breast cancer by radical mastectomy with simple closure of the wound and by radical mastectomy with closure by skin graft. Closure after radical mastectomy by free skin graft was first employed because the removal of a margin of skin sufficient to guard against the probability of local recurrence left a defect so large that primary suture often was not possible. However, closure by skin graft has been advocated by those who feel that extremely wide excision of skin and subcutaneous tissue is the best protection against regional recurrence. Also, the examination of patients after operation has given information which shows that the use of a primary graft in the closure of the wound of radical mastectomy results in the preservation of full function of the arm in a high percentage of cases. In this study patients have been examined postoperatively and records have been analyzed closely in an attempt to determine the actual role played by the additional step of skin grafting after radical mastectomy. Data which point out the value of the skin graft in relation to final function of the arm are presented herein.

The basis of the clinical study are 389 patients on whom radical mastectomy was performed on the surgical service of The New York Hospital from Sept. 1, 1932, to Dec. 31, 1946. Of this number, thirteen are excluded because of death soon after operation or because mastectomy had been done as a palliative operation for advanced disease. Bilateral mastectomy was done in eight cases. Thus it has been possible to study the effect of type of operation upon the function of the arm in 384 cases. The patients were examined at the time of their semiannual visits to the surgical follow-up clinic of The New York Hospital.

Operative surgery in these cases was done by twenty-five different surgeons, most of whom served as resident surgeon at the time. The basic steps of radical mastectomy followed the technique of Halsted.[1, 2] These steps may be enumerated: (1) preliminary biopsy with microscopic examination (frozen section) to ascertain the nature of the tumor; (2) preparation of the skin of the thigh as the donor site for a thick-split graft of skin; (3) use of a circular or elliptical incision about the tumor at a distance of at least 5 cm. from its palpable margins, regardless of which quadrant of the breast is involved; (4) extension of the incision from its central ellipse, superiorly to the middle or lateral third of the

clavicle and inferiorly to the costal margin; (5) reflection of flaps of skin (with a small amount of subcutaneous tissue) superiorly to the clavicle, medially to the midsternum, inferiorly to the fascia of the rectus muscle, and laterally to the border of the latissimus dorsi muscle and to the insertion of the pectoralis major muscle, thus exposing the axilla; (6) detachment of the pectoralis major and minor muscles and their fasciae from their origins on the chest wall and their insertions into the humerus and the coracoid process; (7) complete dissection of the axillary vein thus permitting removal of all of the contents of the axilla including lymphatic vessels and glands, adipose and areolar tissue; (8) removal of breast, axillary contents, and pectoralis major and minor muscles en masse; (9) reconstruction of a *high* axilla by obliteration of dead space and suture of the upper and outer cutaneous flap to the chest wall immediately posterior and inferior to the axillary vein; (10) suture of the margins of the cutaneous flaps superior to, medial to, and inferior to a central defect on the chest wall; suture is effected without undue tension while the arm is held in abduction at an angle of ninety degrees; (11) application of a thick-split skin graft to the residual open wound on the chest wall, and (12) application of a suitable dressing to maintain pressure upon the graft and the flaps and to immobilize the arm in slight abduction.

ANALYSIS OF DATA

Of the 384 cases the records of which were reviewed for this analysis, the data were sufficiently complete in 308 to permit their inclusion in this report on evaluation of the use of a skin graft in radical mastectomy as a step in arrival at the goal of tumor cure with good function of the arm.

The results regarding function of the arm have been classified as follows: (1) poor (motion limited to less than 90 degrees abduction); (2) good (motion in the range of greater than 90 degrees of abduction, but less than 160 degrees); and (3) excellent (motion greater than 160 degrees of abduction and for all practical purposes as free as in the opposite extremity). In addition to range of abduction, certain other considerations, such as the degree of freedom from pain or motion and the degree of retention of power in the shoulder joint should, perhaps, be given great weight but these have not been considered separately, partly owing to lack of satisfactory follow-up information.

The methods which surgeons had utilized for closure of the wounds are classified as follows: (1) closure without graft; (2) use of a small graft for closure (less than 60 sq. cm. in area); (3) use of a large graft for closure (greater than 60 sq. cm. in area); and (4) use of a graft the size of which was not recorded.

In 95 of the 308 patients closure was without a graft and of these, 22, or 23 per cent, had poor function of the arm. Closure with a small graft was used in 131 and of these only 19, or 14.5 per cent, had a poor functional result. Fifty-nine closures were with a large graft and in 16, or 27 per cent, results were poor. Twenty-three closures were with a graft of indeterminate size and of these 3, or 13 per cent, had poor function. Although the size of the graft was not given

TABLE I. RADICAL MASTECTOMY (308 CASES)
Evaluation of Function of Arm in Relation to Use of Thick-Split Skin Graft

	CLOSURE WITHOUT GRAFT		CLOSURE WITH SMALL GRAFT		CLOSURE WITH LARGE GRAFT		CLOSURE WITH GRAFT OF UNKNOWN SIZE		TOTALS	
	NO.	PER CENT	NO.	PER CENT	NO.	PER CENT	NO.	PER CENT	NO.	PER CENT
Poor function	22	23	19	14.5	16	27	3	13	60	19
Good function	48	51	55	42	21	36	10	43.5	134	44
Excellent function	25	26	57	43.5	22	37	10	43.5	114	37
Number of cases	95		131		59		23		308 cases	

for these 23 cases, it may be presumed that the grafts were small rather than large for otherwise the surgeons would have been constrained to comment more accurately concerning the exact size of the graft employed. This conjecture seems to be borne out in the close parallelism of the results following the use of small grafts and the results after use of grafts of indeterminate size (Table I).

The postoperative treatment of radical mastectomy often included radiation therapy. Because of the erythema, inflammation, and fibrosis which such therapy may induce in the soft tissues of the chest wall and axilla, it is of interest to compare the functional results in patients who were given radiation with those who had not been so treated. Of 285 cases in which both the functional results and the size of graft are known, 150 patients were treated postoperatively by x-ray therapy. Of these 36, or 24 per cent, had a poor functional result. One hundred and thirty-five did not receive x-ray therapy and of these only 21, or 16 per cent, had a poor result (Table II). From these percentages, it appears that the use of x-ray postoperatively increases the probability of poor function of the arm.

Further analysis shows that x-ray therapy was associated with a higher percentage of poor functional results whether or not the wound was closed with a graft. Of the 95 wounds closed without a graft, x-ray therapy was used in 47 and there were poor functional results in 15, or 32 per cent. X-ray therapy was not used in 48 and of these there were poor results in only 7, or

TABLE II. RADICAL MASTECTOMY (285 CASES)
Evaluation of Function of the Arm in Relation to Use of Thick-Split Skin Graft and Postoperative X-ray Therapy

	CLOSURE WITHOUT GRAFT		CLOSURE WITH SMALL GRAFT		CLOSURE WITH LARGE GRAFT		TOTALS	
	NO.	PER CENT	NO.	PER CENT	NO.	PER CENT	NO.	PER CENT
Postoperative x-ray therapy								
Poor results	15	32	10	15	11	29	36	24
Good results	19	40	29	45	16	42	64	43
Excellent results	13	28	26	40	11	29	50	33
Total	47		65		38		150	
No x-ray therapy							21	16
Poor results	7	15	9	14	5	24	60	44
Good results	29	60	26	39	5	24	54	40
Excellent results	12	25	31	47	11	52	135	
Total	48		66		21		285	
Grand total	95		131		59			

15 per cent. Of the 131 wounds closed with a small graft x-ray therapy was used in 65 and of these there were poor results in 10, or 15 per cent. X-ray therapy was not used in 66 and there were poor functional results in 9, or 14 per cent. Of the 59 wounds closed with a large graft, x-ray therapy was used in 38 and of these there were poor results in 11, or 29 per cent. X-ray therapy was not used in 21, and of these there were poor results in 5 or 24 per cent.

Since x-ray therapy and closure of the wound without grafting both adversely affect the percentage of good functional results, it might be expected that their combined use would lead to the highest incidence of poor functional results. This is borne out in the analysis. Thirty-two per cent of patients whose wounds were closed without grafting and who then received x-ray therapy had poor function of the arm, whereas only 15 per cent of patients whose wounds were closed with a small graft and who did not receive x-ray therapy had poor results. The reporting of fewer good functional results following x-ray therapy is not advanced as an argument for the discontinuation of this treatment since it has been shown that the percentage of five-year cures can be improved with postoperative x-ray therapy.[3]

The development of edema of the arm following radical mastectomy is a factor which influences the function of the arm. For 287 cases, information as to the amount of edema as well as the functional result is available.

The patients were divided into three groups: (1) without edema; (2) with moderate edema (less than 2 cm. increase in circumference as compared with the unoperated side), and (3) with marked edema (more than 2 cm. increase in circumference). Of the 129 patients without edema, 17, or 13.5 per cent, had poor function; of the 124 patients with moderate edema, 21, or 17 per cent, had poor function; of the 34 patients with marked edema, 12, or 35 per cent, had poor function (Table III). Although it was apparent from the follow-up notes that edema of the arm did not in itself lead to poor function, it does appear that a considerably higher percentage of patients with edema had poor function. It has already been demonstrated that postoperative infection, either of the mastcetomy wound or of the extremity, is an important cause of edema.[4] It may be that lessened activity of the extremity which accompanies poor function is a contributory influence.

Because the operation of radical mastectomy, whether accompanied by grafting or not, usually is associated with a period of postoperative immobilization, the patient's age might be expected to influence the end result. For evalua-

TABLE III. RADICAL MASTECTOMY (287 CASES)
Relation of Swelling of Arm to Function of Arm

	POOR FUNCTION		GOOD FUNCTION		EXCELLENT FUNCTION		TOTALS
	NO.	PER CENT	NO.	PER CENT	NO.	PER CENT	
No swelling	17	13.5	58	45	54	42	129
Moderate swelling	21	17	58	47	45	36	124
Marked swelling	12	35	11	32.5	11	32.5	34
Total	50		127		110		287

tion of this factor the patients were divided into groups: (1) age 21 to 35 years; (2) age 36 to 50 years; (3) age 51 to 65 years; and (4) age 66 years or older.

TABLE IV. RADICAL MASTECTOMY (300 CASES)
Relation of Age of Patient to Function of the Arm

	POOR FUNCTION		GOOD FUNCTION		EXCELLENT FUNCTION		TOTALS
	NO.	PER CENT	NO.	PER CENT	NO.	PER CENT	
21 to 35 yr.	3	16	5	26	11	58	19
36 to 50 yr.	30	19.5	66	43	58	37.5	154
51 to 65 yr.	19	18	57	54	29	28	105
66 plus yr.	6	27	9	41	7	32	22
Totals	58		137		105		300

As can be seen in Table IV the percentage of poor results is greater in the advanced age decades. In the youngest group, there is 16 per cent of poor results, whereas in the oldest age group, there is 27 per cent.

DISCUSSION

It is apparent from a study of the patients included in this report that excision of a wide margin of skin, followed by reconstruction of a high axilla, approximation of cutaneous margins without undue tension, and the application of a thick-split skin graft to the residual defect is rewarded by good or excellent function of the arm in a high percentage of cases. In fact, the percentage of patients who exhibited full function of the arm after such operative care was nearly twice that of the patients treated by simple closure of the wound. It is true that a small tumor may be excised with a wide margin of adjacent skin still leaving enough skin for closure of the cutaneous margins without tension, as the arm is held in the position of right angle abduction. In other cases closure without much tension can be effected by bringing the arm nearer the side. Again, closure can be effected without a graft simply by the use of especially strong suture material to bring and hold the cutaneous margins in approximation. In each of these three methods of closure the horizontal elasticity of the skin lateral to the line of closure is utilized to help effect the closure. This skin has great elasticity, but it seems unwise, if one wishes to maintain full range of motion of the arm, not to preserve all of it for the purpose for which it was originally intended. Axillary skin and subcutaneous tissue are naturally abundant in order to provide for abduction and elevation of the arm.

The skin of the anterior axillary fold, as well as the skin of the anterior chest wall, has a remarkable degree of elasticity which comes into use during abduction. The reconstruction of the high axilla as recommended by Halsted shifts the lateral cutaneous flap to the area of the axilla where a small amount of elasticity has maximal degree of usefulness. Some of the elasticity of this lateral flap is utilized to effect closure about the axillary vein in the reconstruction of the high axilla.

These two considerations, then, the stretching of skin medially to close the defect of the anterior portion of the chest wall and the stretching of the skin of

the anterior axillary fold superiorly to reconstruct a high axilla, make use of contiguous skin for repair of a surgical defect and thus serve to limit the amount of elasticity remaining for use when the arm is abducted. The suggestion is offered that the arm be placed at an angle of abduction slightly greater than 90 degrees and in external rotation before attempt is made to suture the cutaneous flaps. Then such portions of the margins of the wound as come together without tension may be approximated. Residual defect on the thoracic cage then may be covered by the application of a thick-split skin graft, after suture of the margins of the wound to the thoracic wall. This latter step is recommended because, unless it is carried out, the skin graft will undergo some contraction and no gain will be obtained from having placed a large graft. The graft should be cut large enough so that it can be approximated to the margins of the defect without tension.

It is believed that this method of closure assures that the axilla and the region of the anterior axillary fold will be covered by sufficient skin and subcutaneous tissue to allow full range of motion of the arm. It is as easy to obtain a relatively large graft as it is to obtain a smaller one. The thigh affords a generous donor site from which grafts of skin measuring 4 by 7 inches may be cut with regularity if a dermatome is applied so that the long dimension of the graft is in the horizontal rather than the longitudinal direction of the thigh. Because the graft is applied to relatively immobile external intercostal musculature and costal periosteum, the graft cannot, of itself, play any important role in the amount of elasticity of regional tissue preserved for abduction. Its usefulness lies in the manner in which it permits the operator to preserve all or most of the elasticity of the skin of the lateral chest wall and anterior axillary fold for abduction of the arm. It is important to preserve such mobility for the younger patient because, if he is cured of carcinoma, longevity is anticipated. Attention to this point also is important for the patients in the advanced decades of life because any diminution of cutaneous elasticity may be expected to reflect itself in further impairment of function owing to the problem of restoration of motion in joints which are immobilized temporarily in older people.

The thickness of split skin employed for the graft deserves consideration. A thick graft is preferable but a thin graft is acceptable since the thoracic wall is exposed to minimal trauma in adults. It is unquestionably important to secure a complete "take" of the graft. Failure of a portion of the graft is followed by infection, a causative factor in the development of edema of the arm. Areas of granulation tissue which undergo contracture before epithelization can undo partially the good functional result that may be expected after every precaution has been taken to supply the axilla with all the skin necessary for complete motion of the shoulder joint. Should any considerable portion of graft fail to grow, it is believed wise to apply a secondary graft as soon as the area can be prepared rather than to wait for epithelium to grow in from the margins of the secondary wound.

It is true that patients whose function of the arm is poor after mastectomy usually do not complain of this handicap. Attention to the problem of function

of the arm is favored rather as something which the surgeon can offer the patient in addition to cure of the carcinoma.

SUMMARY

Function of the arm following radical mastectomy for carcinoma of the breast has been reviewed in 308 cases. The technique of the radical amputation of Halsted was followed in each case but there was variation in the type of closure. In 95 cases the wounds were closed by linear suture, without the use of a skin graft. In 131 cases a small skin graft was used, and in 59 cases a large skin graft was employed to cover the residual defect on the chest wall. Closure with a small graft was followed by full function of the arm in the highest percentage of cases. The use of postoperative x-ray therapy (regardless of type of closure of the wound) was associated with an increased percentage of patients who showed poor function of the arm. Other significant factors such as postoperative edema of the arm and the age of the patient have been taken into consideration in evaluation of the function of the arm after radical mastectomy. Data are listed which indicate that the closure of the wound of radical mastectomy by thick-split graft of skin is rewarded by full function of the arm in a higher percentage of cases than when simple linear closure is used. By the use of a thick-split skin graft, the elasticity of the lateral cutaneous flap, which normally allows for the full abduction of the arm, may be preserved. Thick-split skin grafts have been found to afford adequate protection for the thoracic wall. The use of a skin graft in the closure of the wound of radical mastectomy is viewed as an operative step which allows the preservation of full function of the arm in a group of patients who have good probability of cure of carcinoma.

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CONSERVATIVE TREATMENT OF FRACTURES OF THE TIBIAL CONDYLES

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FRACTURES of the proximal end of the tibia extending into the joint are generally produced by either direct blows against the medial or lateral aspects of the knee or by forces directed along the shafts of the tibia or femur as in falling on the almost extended knee. Associated with this type injury, particularly following a direct blow to the knee, there may be varying degrees of disruption or of stretching of the collateral and cruciate ligaments. These fractures generally involve one but may involve both condyles with a variable degree of comminution or impaction of the bony fragments. The bony fragments may be displaced toward the medial or lateral aspect of the tibia or may be pushed down the shaft.

Because of concern that anything short of careful replacement of the fragments would likely produce a traumatic arthritis or osteochondritis dissecans, treatment of this injury most often has been directed toward as careful replacement as was possible of the fragments to re-establish a flat tibial table. The generally accepted methods for re-establishing the continuity of the tibial table include nonoperative compression manipulation by cabinetmaker's clamps, or operative replacement of the fragments and fixation of the fragments by means of screws, iron stove bolts, or grafted bony shelves.

In the case of the markedly debilitated adult, in the aged, or in a patient suffering with systemic contraindications to the vigorous pursuit of repositioning the tibial condyle fragments, a more conservative type of therapy seemed advisable. The cases reported here occurred in elderly women who either because of the extent and seriousness of their injuries or because of other contraindications to operative therapy were treated by immobilization of the affected limb on a posterior plaster splint extending from the toes to the upper thigh. By placing the thigh and lower leg in normal alignment the knee was maintained in a normal position for four weeks. During the first week it was necessary to tap the knee joint for bloody fluid to relieve the local discomfort. At the end of one month the patient was fitted with a pelvic weight-bearing walking caliper articulated at the knee and by this means weight-bearing was begun and continued for two months. At this time physiotherapy in the form of thermobridge, diathermy, and controlled active and passive motion was administered once per week. During the fourth month following the injury gradual weight-bearing without the walking caliper was permitted if there was x-ray evidence of bony union of the fracture. If x-ray evidence of bony union was lacking, the caliper support was continued and free weight-bearing permitted only after there was definite evidence of a healed fracture.

CASE REPORTS

CASE 1.—E. K., a woman, aged 55 years, was admitted to the surgical service of the New York Hospital soon after having been struck by the bumper of an automobile. She was unable to bear weight on the left leg and complained bitterly of pain along the lateral aspect of the left knee. There was moderate distention of the joint by fluid and there were contusions about the knee. There was no evidence of injury of the collateral or cruciate ligaments. There were striking osteoarthritic changes in the hands and left knee. An x-ray examination revealed a markedly comminuted impacted fracture of the lateral condyle of the left tibia with approximately ½ cm. of downward and lateral displacement of the fragments. The anterior portion of the lateral table was considerably more depressed than the posterior.

Fig. 1.—X-ray views taken two years after injury revealed a healed fracture of the lateral condyle of the left tibia with depression of this table level. The joint interval in the lateral half was increased due to the depression of the tibial table but the level of the femoral condyles was maintained and the alignment of the tibial and femoral shafts showed only slight varus deformity.

Because of the patient's rather poor general condition, the presence of osteoarthritis of several joints, and her own objection to operative treatment of the fracture, the right leg was immobilized in a posterior plaster splint extending from the toes to the upper thigh. One month after this period of immobilization a pelvic weight-bearing walking caliper, articulated at the knee, was fitted and the patient mobilized during the succeeding nine weeks with the assistance of crutches and later a cane. During this time weekly physiotherapy was provided and this included infrared, gentle massage, and flexion-extension movements of the knee. Four months after the injury the x-ray picture revealed healing of the tibial fracture with adequate callus formation. The position of the tibial table fragments remained unchanged. The walking caliper was discarded at this time and weight-bearing gradually developed during the succeeding months. Six months after injury the patient walked up and down stairs without pain or evident weakness.

At this time, two years after the injury, there was slight varus deformity of the knee. The knee could be actively and passively flexed to 90 degrees and extended to 180 degrees

without discomfort. The patient walked about without a limp and experienced no discomfort upon climbing or descending stairs. Cold, damp weather produced slight stiffness of the knee without pain or swelling. An x-ray view (Fig. 1) revealed a healed fracture of the lateral condyle of the left tibia with depression of this table level. The joint interval in the lateral half was increased due to the depression of the tibial table, but the level of the femoral condyles was maintained and the alignment of the tibial and femoral shafts showed only slight varus deformity. There was moderate osteoporosis of the tibia and femur.

CASE 2.—A. L., a woman aged 62 years, was admitted to the surgical service of the New York Hospital soon after having slipped from the top rung of a six-foot ladder, landing on her feet. She was unable to bear weight on the right leg and complained of pain along the medial aspect of this knee. There was a fracture of the right radius. There was no evidence of injury of the collateral or cruciate ligaments or of the articular cartilages.

Fig. 2.—X-ray examination of the right knee performed 3½ years after injury disclosed a healed fracture of the medial condyle with distal displacement of this part of the tibial articulating table. The joint interval on the medial half was increased due to depression of the tibial table. However, the level of the femoral condyles was maintained and the alignment of the tibial and femoral shafts showed only slight varus deformity.

A right nephrectomy for hydronephrosis had been done fourteen years before the accident.

The x-ray examination of the time of admission disclosed a comminuted fracture of the medial condyle of the right tibia. There was lateral and distal displacement of the fragments with moderate varus deformity.

Two days after admission 70 c.c. of bloody fluid were aspirated from the knee joint effecting marked relief of the local discomfort. Because of the nephrectomy and poor general condition the limb was immobilized on a posterior plaster splint extending from the toes to the midthigh. Six weeks later because this patient could not afford a walking caliper a skin type plaster cast was applied to the right leg from the upper thigh to the toes incorporating in the cast a walking iron. Employing crutches minimal weight-bearing was permitted on the right leg during the succeeding eight weeks.

Three months after injury x-ray examination showed healing of the fracture of the medial condyle of the right tibia with callus formation and obliteration of the fracture line. There was some depression of the medial table and minimal varus deformity of the knee. There was moderate osteoporosis of the visible portions of the femur and tibia. A course of physiotherapy including thermobridge, diathermy, medium massage, and active and passive exercise of the knee was administered twice weekly during the next month and weekly during the fifth month after injury. Six months after injury the patient was able to walk without discomfort or limitation of motion. Slight swelling of the knee occurred during cold damp weather particularly after a full day of walking.

At this time, three and one-half years following the injury, there was slight varus deformity of the knee. The knee could be actively and passively extended to 180 degrees and flexed to 90 degrees without discomfort. She walked with a slightly perceptible limp and there was slight discomfort in climbing or descending stairs. Occasionally, during a hurried attempt to board a bus, as she stepped up, the knee seemed weak and she was obliged to grasp the safety rail. There was no swelling of the knee despite an active life. An x-ray view (Fig. 2) of the right knee disclosed a healed fracture of the medial condyle with distal displacement of this part of the tibial articulating table. The joint interval on the medial half was increased due to the depression of this portion of the tibial table. However, the level of the femoral condyles was maintained and the alignment of the tibial and femoral shafts showed only slight varus deformity.

Fig. 3.—X-ray examination of the right knee at the time of admission revealed a comminuted impacted fracture involving the lateral tibial condyle with moderate lateral and distal displacement of the fragments.

Case 3.—H. C., a woman aged 67 years, was admitted to the surgical service of the New York Hospital soon after having been struck by the bumper of a taxicab. She was in profound shock. In addition to the fracture of the lateral condyle of the right tibia and weakness of the medial collateral ligaments of the right knee, there were multiple fractures of the pelvis and a compound, markedly, comminuted fracture of the left tibia and fibula.

An x-ray view (Fig. 3) of the right knee revealed a comminuted, impacted fracture involving the lateral tibial condyle, with moderate lateral and distal displacement of the fragments.

Fig. 4.—This x-ray picture taken four months following the injury disclosed a healing fracture of the lateral portion of the left tibial table with adequate callus formation. The position of the fragments remained unchanged. There was moderate osteoporosis of the visible portions of the tibia and femur.

Fig. 5.—Roentgenograms of the right knee taken 1½ years after the injury showed a healed fracture of the lateral condyle of the tibia with distal displacement of this part of the articulating table. The joint interval in the lateral half of the joint was increased due to the depression of the tibial table. The lateral femoral condyle was slightly below the level of the medial condyle and suggested a minimal varus deformity. The alignment of the tibial and femoral shafts showed minimal varus deformity.

Because of the patient's poor condition and the multiple injuries, the right leg was immobilized in a posterior plaster splint extending from the upper thigh to the toes. Five weeks after admission, although she was confined to bed, physiotherapy, including massage and flexion-extension movements were carried out daily by the patient, who was an experienced masseuse. Four months after admission (see Fig. 4), when there was x-ray evidence of bony union of the fractures, weight-bearing was begun.

At this time, one and one-half years following the injury, there was slight varus deformity of the right knee. The knee could be actively and passively flexed to 90 degrees and extended to 180 degrees without discomfort. The patient walked with a slightly perceptible limp that seemed due to the slight deformity of the right knee and the partly stiffened left ankle. There was no discomfort or weakness upon climbing or descending stairs. Only slight swelling of the right knee, which was not painful, occurred in cold, damp weather. Except for the slight varus deformity of the right knee, at this time, there was no evidence of injury of the collateral or internal ligaments of the right knee.

An x-ray picture (Fig. 5) showed a healed fracture of the lateral condyle of the tibia with distal displacement of this half of the articulating table. The joint interval of the lateral half of the joint was increased due to the depression of the tibial table. The lateral femoral condyle was slightly below the level of the medial condyle and therefore suggested minimal varus deformity. The alignment of the tibial and femoral shafts showed minimal varus deformity.

DISCUSSION

Fractures extending through the tibial articular cartilage and the subjacent cancellous bony table of the tibia healed by means of fibrocartilage growing from the tibial bone through the fracture fissures into the joint.[1, 2, 3, 4] In the group of young patients this healing mechanism is often vigorous and in healing intra-articular fibrocartilaginous irregularities may occur in the tibial table surface producing pain and limitation of motion. In this group of patients irregularities in the cancellous bony surface with protruding bony elements as a result of poor position of a tibial condyle fracture may heal producing intra-articular bony spurs that may be painful and usually limit the range of motion. Fairly marked degrees of valgus or varus deformity of the knee may result from irregularities in the development of tibial cancellous bone and fibrocartilage reconstituting the articular surface.

In the young patient who has sustained injury to the tibial condyle, since subsequent vigorous use of the joint is generally contemplated, it is desirable that the fragments of a fracture of the tibial condyle be replaced to as normal position as possible to reduce the size of fracture fissures and bony prominences. Operative care is usually employed since the fragments of the injured condyle may have to be maintained by screws, bolts, or a built-up subcondylar bony shelf.

In the older patient the cancellous bone is softer, osteoporotic and following injury may be demineralized. The irregularities of the surface fragments of the fractured tibial condyle tend to be demineralized rather than to form tough bony spurs that may extend into the joint. In this group of patients the production of fibrocartilage that will ultimately produce union of the tibial condyle fragments and fill defects in the tibial articular surface is not vigorous.

One of us (N. W. C.) has had an opportunity to study cases of this last type in which exploration was done for the correction of internal ligamentous derangements or the removal of a torn semilunar cartilage, several months after

treatment of a fracture of the tibial condyle. The tibial articular surface was covered with a smooth, gray, shiny layer of fibrocartilage (Fig. 6). This fibrocartilage had grown from the tibial cancellous bone through the fissures in the fractured condyle to fill the defects in the tibial cartilaginous articular surface.

During the period of healing of these fractures, if the body weight transmitted through the femoral condyle above the fractured portion of the tibial table has not been permitted to impinge on the tibial table, the regenerating fibrocartilage will extend over the surface of the injured portion of the table effecting a flat surface (Fig. 6).

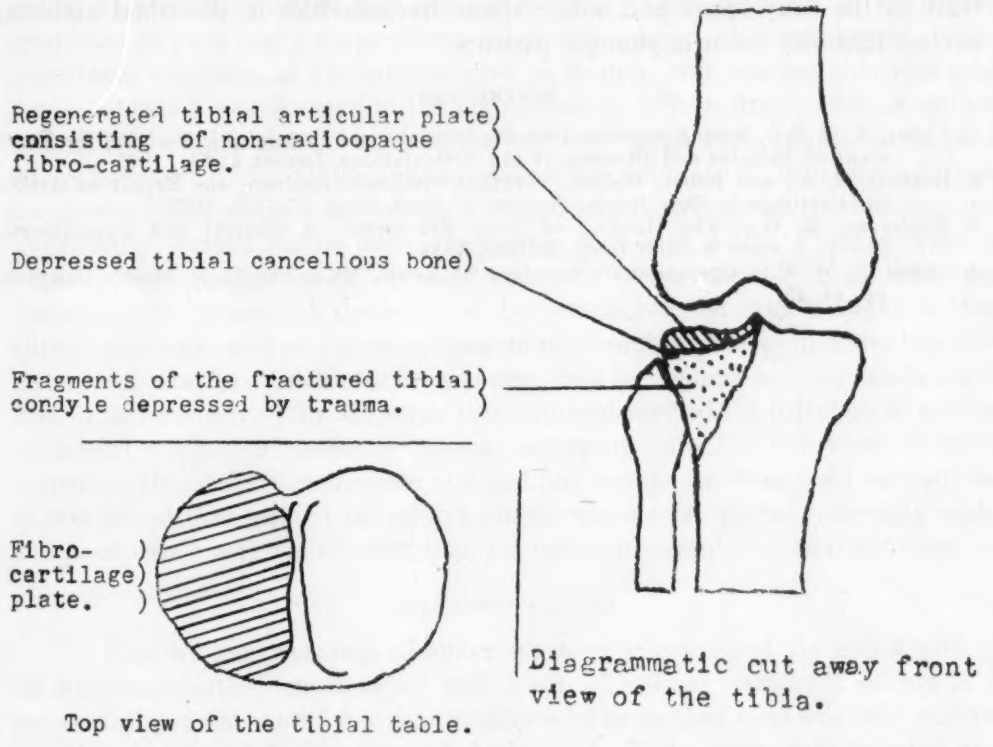
Regenerated tibial articular plate consisting of non-radioopaque fibro-cartilage.
Depressed tibial cancellous bone)
Fragments of the fractured tibial condyle depressed by trauma.
Fibro-cartilage plate.
Top view of the tibial table.
Diagrammatic cut away front view of the tibia.

Fig. 6.—The fibrocartilage that proliferated from the tibial cancellous bone to produce union of the fracture of the tibial condyle may extend over the surface of the injured portion of the tibial table to produce a level articulating surface.

This newly formed articular surface cannot be visualized in x-rays since it rarely contains bony elements. One can readily infer its presence, for the alignment of the femoral condyles is normal and the alignment of the femoral and tibial shafts shows no valgus or varus deformity.

The roentgenologist generally reports widening of the joint space on the side of the old injury to the tibial condyle. This apparent widening of the joint space as seen in the roentgenograms (Figs. 1, 2, and 5) represents an increase in the width of the nonradiopaque tissue present between the cancellous bony surfaces of the femoral condyle and the re-established tibial condyle. Fibrocartilaginous tissue in these joints has re-established the tibial articular surface at a level that is recognized as normal if x-ray views of the injured and uninjured knee are compared.

SUMMARY AND CONCLUSIONS

The successful nonoperative treatment of fractures of the tibial condyles was accomplished by initial immobilization of the limb in a plaster splint and subsequent use of ischial weight-bearing walking caliper or walking type cast for ambulation. The relatively flat continuity of the tibial articular surface in the older patient can be re-established without intra-articular bony spurs and soft tissue irregularities in the joint surface by fibrocartilage growing from the tibial cancellous bone through the fissures in the fractured portion of the injured tibial condyle. This type healing of the tibial table fractures is in contrast to the bony spurs and softer tissue irregularities in the tibial articular surface that may occur in younger patients.

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THE USE OF SODIUM TETRADECYL SULFATE IN THE SCLEROSING TREATMENT OF VARICOSE VEINS

An Experimental and Clinical Study

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SCLEROTHERAPY in the treatment of varicose veins has become a routine and successful method of dealing with this condition in suitable ambulatory patients. The results have been good and serious complications have been few owing to careful selection and good technique. Due, however, to subjective symptoms of pain and cramps all too often encountered when employing strong hypertonic solutions of crystalloids such as sodium and calcium chlorides and sugar, attention was directed to the soap solutions. These drugs, such as sodium morrhuate, sodium ricinoleate, sodium psylliate, monoethanolamine oleate, and others have largely supplanted the crystalloids in popularity. The soap solutions are better tolerated but distressing allergic manifestations of troublesome and occasionally serious nature have frequently been met with. Further there is evidence that recanalization detracts from the effectiveness of these solutions. Consequently, it seemed desirable to try another agent which might be less allergically toxic and at the same time more thrombogenic* even while less irritating and painful. Such a drug was described by Reiner[1] and was made available to us for study.† In his paper this author described the injection of sodium tetradecyl sulfate, a synthetic anionic detergent, into the tail veins of mice. Concurrently, sodium ricinoleate and sodium morrhuate were used as controls. It was found that sodium tetradecyl sulfate was a more potent sclerosing agent and produced less tissue reaction than the commonly employed soap solutions.

EXPERIMENTAL USE

1. Healthy mongrel dogs of either sex were selected and the major vein of all four extremities was injected with 3 c.c. of sodium tetradecyl sulfate in 1 per cent, 3 per cent and 5 per cent solutions. The method used was the "empty-vein" technique of McPheeter and Anderson.[2] Forty veins were injected and excised at the end of five days for microscopic examination. It was readily concluded that the solutions were effective in causing good thrombosis in the large majority of veins. There were some failures where the 1 per cent solution was used and instances of local irritation and reaction when the 5 per cent solution was employed. Since there was no apparent histologic difference in the obliteration effect between the 3 per cent and 5 per cent solution it was concluded that the former would be more satisfactory for clinical trials. There was no sloughing from inadvertent perivenous infiltration nor was there any evidence of a systemic reaction in any animal.

2. Intradermal wheals were raised on the backs of both dogs and rabbits using 0.4 and 0.2 c.c., respectively. Sodium tetradecyl sulfate, sodium

*The question of whether thrombosis is necessary for satisfactory sclerotherapy has long been discussed. There are some who feel that coaption of vein intima with fibrosis is necessary for satisfactory obliteration; that true sclerosis is not obtained by thrombus formation followed by organization. At the present this question is being studied in our laboratory and will be the subject of a separate communication.

†Supplied by Wallace & Tiernan Products, Inc., as Sotradecol.

morrhuate, and sodium ricinoleate were compared and although sloughing occurred in every instance the areas with their surrounding zone of inflammation were 50 to 80 per cent smaller with the test drug than with the soap solution controls.

3. Four series of five dogs each were chosen for study. The first group was fasted until the serum protein determination in every instance was 4.8 or below. Their veins were then injected as in Experiment 1 with 3 per cent sodium tetradecyl sulfate, 5 per cent sodium morrhuate, and 5 per cent sodium ricinoleate. The veins were sectioned at the end of seven days and all showed satisfactory obliteration.

In the second and third series the animals were fed 50 mg. of dicumarol daily until the prothrombin time was elevated to levels of from 50 to 140 seconds. (Normal levels in all dogs ranged from 8 to 11 seconds.) In all these animals the bleeding and clotting time was markedly elevated. Hemorrhagic tendencies were controlled by vitamin K but not until forty-eight hours after injection of the sclerosing drugs. The same sclerotics were again compared and, in addition, monoethanolamine oleate was used. There was a 50 per cent over-all failure of thrombosis which appeared in no way dependent on which sclerotic was used or to what relative level the prothrombin time was increased.

A final group was run as in the second and third series again employing dicumarol to prolong the prothrombin time. In these animals, however, sodium tetradecyl sulfate was used in 5 per cent concentration instead of 3 per cent. In this group the test drug gave an effective incidence of obliteration more than twice that of the other drugs both in number and degree. Still, however, there were random failures with sodium tetradecyl sulfate, even when one vein in the same animal showed complete success. These and other experiments using sclerotics in animals with depressed serum protein and in heparinized and dicumarolized dogs have been done and data concerning the effect of thrombogenic agents on the clotting mechanism will be reported separately since these are not considered within the scope of this paper.

CLINICAL USE

Reports on the use of sodium tetradecyl sulfate in the treatment of patients have been made by Cooper[3] and Hirschman,[4] who have concluded that this drug is more satisfactory in obliterating varicose veins; in accomplishing the desired end it causes less painful local reaction with a minimal risk of serious systemic complications than the commonly employed soap solutions. We have used this drug in approximately 200 injections using 66 patients from our varicose vein

TABLE I

			NUMBER
Obliteration			
Excellent			34
Good			8
Questionable			2
	NONE	MILD	SEVERE
Side Effects (Local)			
Pain	35	8	1
Irritation	42	2	0
Slough	40	3	1
Disability	43	1	0
Systemic reaction	39	4	1

clinic. In one-half of the patients it was the first time they had received sclerotherapy and the remainder had received injections with monoethanolamine oleate. Approximately 10 per cent of this half were chosen because they had encountered severe local reactions with pain and inflammation or had suffered allergic systemic reactions. Criteria in judging results were those commonly accepted in this type of therapy, namely, the extent and permanency of obliteration per injection, associated with the absence of undesirable local and systemic reaction. These may be quickly seen in Table I which includes only forty-four patients on whom adequate follow-up study was possible.

In 75 per cent of the injections the 3 per cent solution was used with a 1 per cent solution being employed in the remainder. Generally the weaker strength was given in subsequent therapy if a patient was noted to have any untoward side effects. In these cases, however, the 1 per cent solution seemed to have adequate thrombogenic potency and distressing pain following its use was uniformly absent. Where feasible, it was our practice to select the lowest available vein of the extremity which had a proved communication with the varicosed segments above either in the lesser or greater saphenous chains. A hypodermic needle was inserted, then the leg was elevated and milked of stagnant blood. A tourniquet was placed high on the thigh and the solution was given in amounts ranging from 1 to 5 c.c. The leg was left elevated with the tourniquet in place for ten minutes. In this fashion, particularly when larger amounts were injected, the resulting segment of thrombosed vein frequently measured as much as 40 and averaged 10 to 20 cm. There was no apparent correlation between painful reactions and the amount of solution which was injected. In no case was there any sudden or serious anaphylactic reaction. The systemic reactions noted consisted of slight fever and chills for a short time, generally noticeable about twenty-four hours after treatment. No reaction was considered severe enough to warrant discontinuation of therapy save in one patient.

It was particularly gratifying to note that the group of patients selected for treatment after having difficulty with sodium monolate were particularly free of untoward symptoms when the treatment was resumed using sodium tetradecyl sulfate.

SUMMARY

The results in experimental and clinical trials using sodium tetradecyl sulfate as a sclerosing agent in the treatment of varicose veins point out distinct advantages for this agent over the more commonly used soap solutions. Animal experiments show it to be a more potent thrombogenic drug and its use in patients has been confirmative. Further, the relative absence of side effects such as pain, redness, swelling, temporary disability and distressing systemic reactions appears to warrant its continued use rather than the widely employed soap solution.

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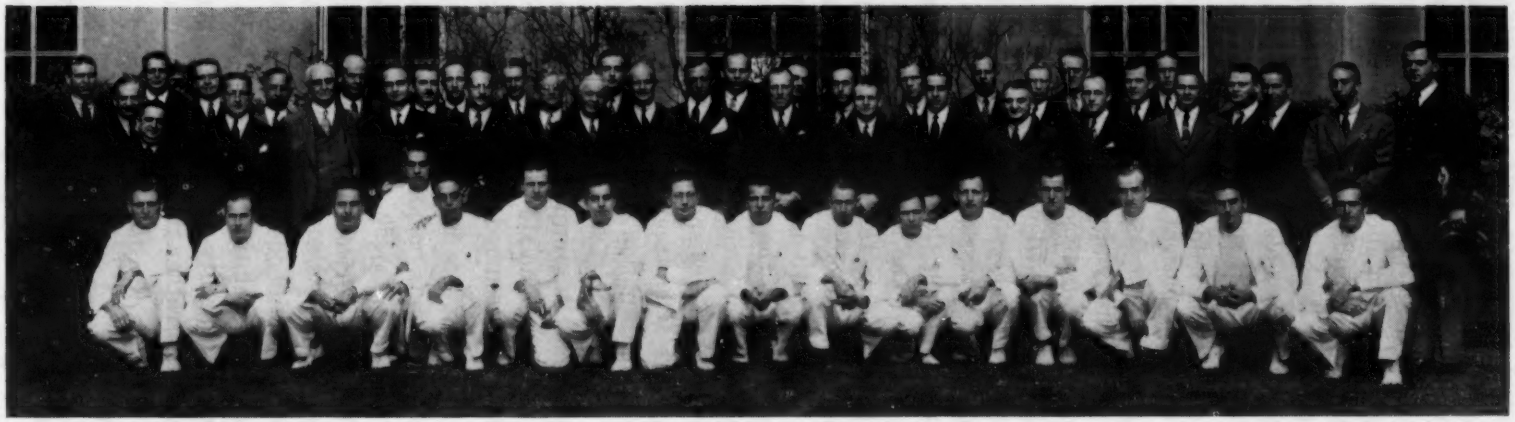

SOME MEMBERS OF DR. HEUER'S STAFF WHO ASSEMBLED FOR A DAY'S PROGRAM AND DINNER IN HIS HONOR AT THE NEW YORK HOSPITAL, NOVEMBER 8, 1941

Standing, back row: Benjamin Hoopes, John Draper, Ralph Bowers, Paul Sutton, James Doster, Herbert Conway, Frank Glenn, Robert Allison, Earl Ferguson, S. W. Moore, Cuyler Hauch, John Eckel, Cranston Holman, E. A. Kindel, Lester Huested, Lloyd Johnston, John West, George Eaton, Paul Hill.

Standing, second row: Joseph Heiman, Walter Reese, William Andrus, John Caldwell, Plato Schwartz, Max Zinninger, Henry Poer, Dr. Heuer, N. C. Foot, B. N. Carter, Beverly Douglas, Merton Griswold, Bronson Ray, Andrew Marchetti, Joseph Kauer, William Sandusky, Edward Douglas, William Cooper, Martin Healy.

Front row: Russell Hooker, James Dingwall, Carl Schmidlapp, Harold Genvert, William Quinn, Charles Neill, William Barnes, Gardner Child, Cooper Person, William Nickel, Arthur Chenoweth, Earl Lasher, Charles Chandler, Donald Morrison, Jere Lord, Eugene Cliffton.

Members of Dr. Heuer's staff not appearing in the picture include: Joseph Artusio, Harold Auerhan, Henry Babers, David Barton, John Beal, Glenn Bell, C. Bidgood, Courtney Bishop, James Boyd, Floyd Bragdon, Charles Brane, Richard Bullard, Sam Burnett, Arthur Console, Malcolm Cook, William Daniel, Armin Darmstaetter, James Davis, Robert Deans, Joseph Donnelly, Howard Dunbar, George Dunlop, Edwin Drew, Warren Eberhart, Adrian Ehler, Basil Faussett, Miles Fellows, Charles Findlay, Joseph Freiberg, Harry Fry, Scott Gardner, Richard Gates, Dan Gill, John Goode, Philip Gordy, John Gratiot, James Green, J. P. Grimes, Vincent Gorman, Glen Harman, Berton Hogle, Henry Hollenberg, George Holswade, Gustavus Humphreys, Francis Jackson, Cedric Jimerson, Charles Jones, Edward Keefer, Lee Kendall, Charles Kirby, George Knapp, Edmund Laird, David Lim-Yuen, Frances Lovejoy, George Lyford, Andrew McBride, Fred McLellan, Barton McSwain, David MacFarland, William Mahoney, Bernard Maisel, Victor Marshall, Guy Maynard, Stephen Meigher, M. C. Menard, H. L. Mikesell, Charles Neumann, Henry O'Brien, John Ogilvie, Earl O'Neill, Ward O'Sullivan, Herbert Parsons, Oliver Purnell, Francis Reinus, Ed Rose, John Schmidt, Morris Schnittman, Trimble Sharber, David Speer, Jean Stevenson, Harmon Truax, Preston Weadon, Willet Whitmore, Roscoe Wilcox, John Willoughby, Joseph Wilson.

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Published by THE C. V. MOSBY COMPANY, 3207 Washington Blvd., St. Louis 3, U.S.A.

Great Britain Agents: Henry Kimpton, Ltd., 26 Bloomsbury Way, London, W.C.1.
Entered at the Post Office at St. Louis, Mo., as Second-Class Matter.

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